Consultation # 2003/00685

National Marine Fisheries Service Endangered Species Act (ESA) Section 7 Consultation Biological Opinion and Magnuson–Stevens Act Essential Fish Habitat (EFH) Consultation

Action Agencies: The National Marine Fisheries Service (NMFS)
The United States Environmental Protection Agency (EPA)
The Bureau of Indian Affairs (BIA)
The United States Geological Survey (USGS)
The United States Forest Service (USFS)
The United States Fish and Wildlife Service (USFWS)
The Bonneville Power Administration (BPA)

Species/ESUs Affected:
Endangered Snake River (SR) sockeye salmon (*Oncorhynchus nerka)*
Threatened SR steelhead (*O. mykiss*)
Threatened SR spring/summer chinook salmon (*O. tshawytscha)*
Threatened SR fall chinook salmon (*O. tshawytscha)*

Essential Fish Habitat (EFH) Affected: Pacific salmon, groundfish, and coastal pelagic species

Actions Considered:

1. Issuance of Permit No. 1124 to the Idaho department of Fish and Game (IDFG)
2. Issuance of Permit No. 1134 to the Columbia River Inter-Tribal Fish commission (CRITFC).
3. Issuance of Permit No. 1140 to NMFS' Northwest Fisheries Science Center (NWFSC).
4. Issuance of Permit No. 1152 to the Oregon Department of Fish and Wildlife (ODFW)
5. Issuance of Permit No. 1156 to the EPA.
6. Issuance of Permit No. 1194 to NMFS' Northwest Fisheries Science Center (NWFSC).
7. Issuance of Permit No. 1205 to the Oregon Department of Environmental Quality (ODEQ)
8. Issuance of Permit No. 1290 to the NWFSC
9. Issuance of Permit No. 1291 to the USGS.
10. Issuance of Permit No. 1322 to the NWFSC
11. Issuance of Permit No. 1366 to the Oregon Cooperative Fish and Wildlife Research Unit (OCFWRU).
12. Issuance of Permit No. 1379 to CRITFC.
13. Issuance of Permit No. 1403 to the NWFSC.

14. Issuance of Permit No. 1406 to the NWFSC.
15. Issuance of Permit No. 1410 to the NWFSC.
16. Issuance of Permit No. 1421 to the USFWS.

Consultation
Conducted by: The Protected Resources Division (PRD), Northwest Region, NMFS Consultation Number **2003/00685.**

This biological opinion constitutes NMFS' review of 16 Endangered Species Act (ESA) section 10(a)(1)(A) permit actions that could affect listed species in the Snake River Basin (i.e., SR sockeye salmon, SR steelhead, SR spring/summer (spr/sum) chinook salmon, and SR fall chinook salmon). It has been prepared in accordance with section 7 of the ESA of 1973, as amended (16 U.S.C. 1531 et seq.). It is based on information provided in the applications for the proposed permits and permit modifications, published and unpublished scientific information on the biology and ecology of threatened steelhead in the action area, and other sources of information. A complete administrative record of this consultation is on file with the PRD in Portland, Oregon.

NMFS concludes that issuing the permits for the proposed research activities discussed in this biological opinion is not likely to jeopardize the continued existence of endangered SR sockeye, threatened SR spr/sum chinook, threatened SR fall chinook, or threatened SR steelhead or destroy or adversely modify their critical habitat. Further, the activities would not adversely affect any designated EFH.

Approved by: for D. Robert Lohn, Regional Administrator
Date: 6/24/2003 (**Expires on:** 12/31/07)

CONSULTATION HISTORY

NMFS proposes to issue 16 permits and permit modifications and thereby authorize the permit holders to conduct scientific research on listed SR sockeye, chinook, and steelhead. The Northwest Region's PRD decided to group these actions into a single consultation pursuant to 50 CFR 402.14(c) because they are similar in nature and duration and will affect the same threatened species. Though some of the proposed permit actions may affect other species as well, this Opinion constitutes formal consultation and an analysis of effects solely for SR sockeye, chinook, and steelhead.

The first of the permit requests was received in December of 2002. It, and several others (though not all) were deemed incomplete to varying degrees when they arrived at the PRD. After numerous phone calls and e-mails, each of the applications was determined to be complete and was then published in a *Federal Register* notice asking for public comment. The public was given 30 days to comment on each application and, once that period closed, the consultation proper was begun. The full consultation histories for all 16 actions are lengthy and are not directly relevant to the analysis for the proposed actions so they will not be detailed here. Nonetheless, the PRD in Portland, Oregon maintains the complete histories for each proposed action in the administrative record for this consultation.

DESCRIPTION OF THE PROPOSED ACTIONS

Common Elements among the Proposed Actions

NMFS proposes to issue or modify 16 permits pursuant to section 10(a)(1)(A) of the ESA. All of the permits would authorize researchers to take threatened, naturally-produced and artificially-propagated,[1] SR spring/sum chinook salmon, threatened SR fall chinook, threatened SR steelhead, endangered naturally-produced and artificially-propagated sockeye salmon all of the above.

Though some of the proposed permits actions may affect other listed species as well as SR fish, this Opinion constitutes formal consultation and an analysis of effects solely for SR steelhead, chinook, and sockeye. Also, some of the activities identified in the proposed permit actions will be funded by NMFS, the EPA, the BIA, the BPA, the USGS, the USFS, and the USFWS.

---

[1] Under NMFS policy, the progeny of hatchery and wild crosses are generally considered listed species for purposes of the ESA (58 FR 17573, April 5, 1993). Artificially-propagated SR spr/sum chinook and SR sockeye salmon—though almost all sockeye are the result of a captive broodstock program—qualify as listed species under this policy and are therefore considered in the analyses throughout this biological opinion.

Although these agencies are also responsible for complying with section 7 of the ESA because they are funding activities that may affect listed species, this consultation examines the actual activities they propose to fund and thus will fulfill their section 7 consultation requirement.

NMFS proposes that all of the permit actions considered in this Opinion should expire on or before December 31, 2007. Also, in all instances where a permit holder does not expect to indirectly kill any juvenile SR steelhead, sockeye, or chinook during the course of his or her work, the indirect lethal take figure has been set at one. The reason for this is that unforseen circumstances can arise on occasion, and NMFS has determined it is best in these instances to include modest overestimates of expected take. By doing this, NMFS gives researchers enough flexibility to make in-season research protocol adjustments in response to annual fluctuations in environmental conditions—such as water flows, larger than expected run sizes, etc.—without having to shut down the research because the expected take was exceeded. Also, high take estimates are useful for conservatively analyzing the effects of the actions because it allows accidents that could cause higher-than-expected take levels to be taken into account during the analysis.

Research permits lay out the terms and conditions to be followed before, during, and after the research activities are conducted. These conditions are intended to (a) manage the interaction between scientists and listed salmonids by requiring that research activities be coordinated among permit holders and between permit holders and NMFS, (b) minimize impacts on listed species, and (c) ensure that NMFS receives information about the effects the permitted activities have on the species concerned. The following conditions are common to all of the permits consulted upon in this Opinion.

In all cases, the permit holder must:

1. The permit holder must ensure that listed species are taken only at the levels, by the means, in the areas and for the purposes stated in the permit application, and according to the terms and conditions in this permit.

2. The permit holder must not intentionally kill or cause to be killed any listed species unless the permit specifically allows intentional lethal take.

3. The permit holder must handle listed fish with extreme care and keep them in cold water to the maximum extent possible during sampling and processing procedures. When fish are transferred or held, a healthy environment must be provided; e.g., the holding units must contain adequate amounts of well-circulated water. When using gear that captures a mix of species, the permit holder must process listed fish first to minimize handling stress.

4. The permit holder must stop handling listed juvenile fish if the water temperature exceeds 70 degrees Fahrenheit at the capture site. Under these conditions, listed fish may only be visually identified and counted.

5. If the permit holder anesthetizes listed fish to avoid injuring or killing them during handling, the fish must be allowed to recover before being released. Fish that are only counted must remain in water and not be anesthetized.

6. The permit holder must use a sterilized needle for each individual injection when passive integrated transponder tags (PIT-tags) are inserted into listed fish.

7. If the permit holder incidentally captures any listed adult fish while sampling for juveniles, the adult fish must be released without further handling and such take must be reported.

8. The permit holder must exercise care during spawning ground surveys to avoid disturbing listed adult salmonids when they are spawning. Researchers must avoid walking in salmon streams whenever possible, especially where listed salmonids are likely to spawn. Visual observation must be used instead of intrusive sampling methods, especially when just determining presence of anadromous fish.

9. The permit holder using backpack electrofishing equipment must comply with NMFS' Backpack Electrofishing Guidelines (June 2000) available at http://www.nwr.noaa.gov/1salmon/salmesa/4ddocs/final4d/electro2000.pdf

10. The permit holder must obtain approval from NMFS before changing sampling locations or research protocols.

11. The permit holder must notify NMFS as soon as possible but no later than two days after any authorized level of take is exceeded or if such an event is likely. The permit holder must submit a written report detailing why the authorized take level was exceeded or is likely to be exceeded.

12. The permit holder is responsible for any biological samples collected from listed species as long as they are used for research purposes. The permit holder may not transfer biological samples to anyone not listed in the application without prior written approval from NMFS.

13. The person(s) actually doing the research must have a copy of this permit while conducting the authorized activities.

14. The permit holder must allow any NMFS employee or representative to accompany field personnel while they conduct the research activities.

15. The permit holder must allow any NMFS employee or representative to inspect any records or facilities related to the permit activities.

16. The permit holder may not transfer or assign this permit to any other person as defined in Section 3(12) of the ESA. This permit ceases to be in effect if transferred or assigned to any other person without NMFS' authorization.

17. NMFS may amend the provisions of this permit after giving the permit holder reasonable notice of the amendment.

18. The permit holder must obtain all other Federal, state, and local permits/authorizations needed for the research activities.

19. On or before January 31st of every year, the permit holder must submit to NMFS a post-season report in the prescribed form describing the research activities, the number of listed fish taken and the location, the type of take, the number of fish intentionally killed and unintentionally killed, the take dates, and a brief summary of the research results. Falsifying annual reports or permit records is a violation of this permit.

20. If the permit holder violates any permit term or condition they will be subject to any and all penalties provided by the ESA. NMFS may revoke this permit if the authorized activities are not conducted in compliance with the permit and the requirements of the ESA or if NMFS determines that its ESA section 10(d) findings are no longer valid.

It should be noted that in this instance "permit holder" means the permit holder or any employee, contractor, or agent of the permit holder.

NMFS may also include additional conditions in a permit based on unique circumstances or the specific mitigation measures proposed by an Applicant. Additional conditions to be included in the permits, if applicable, are identified in the following descriptions of the proposed activities for each individual permit action.

Finally, NMFS will use the annual reports to monitor the actual number of listed fish taken annually in the scientific research activities and shall adjust annual permitted take levels if they are deemed to be excessive or if cumulative take levels rise to the point where they are detrimental to the listed species.

The Individual Permits

Permit 1124

The Idaho Department of Fish and Game (IDFG) is requesting a 5-year permit renewal for seven study tasks that, among them, would annually take adult and juvenile threatened SR fall chinook salmon; adult and juvenile threatened spring/summer SR chinook salmon (natural and artificially propagated); and adult and juvenile endangered SR sockeye salmon in the Salmon and Clearwater River subbasins in Idaho. The original Permit 1124 was in place for five years (63 FR 30199) with one amendment (67 FR 34909); it expires on June 30, 2003. It contained the same eight research tasks being requested under this permit application: Task 1 - General fish population inventory; Task 2 - Spring/summer chinook salmon natural production monitoring and evaluation; Task 3 - Spring/summer chinook salmon supplementation research; Task 4 - Redfish Lake, Pettit Lake, Alturas Lake kokanee/sockeye research; Task 5 - Salmon and steelhead fish health monitoring; Task 6 - Steelhead natural production monitoring and evaluation; Task 7 - Steelhead supplementation research; and Task 8 - Fish rescue/salvage. Under these tasks, listed adult and juvenile salmon would be variously (a) observed/harassed during fish population and production monitoring surveys; (b) captured (using seines, trawls, traps, hook-and-line angling equipment, and electrofishing equipment) and anesthetized; (c) sampled for biological information and tissue samples, (d) PIT-tagged or tagged with radio transmitters or other identifiers, and (e) released. (Some fish would also be rescued from stranding and transported to a safe place in the river, and some sockeye would be transported to improve their survival.) Some fish would die as a result of the research activities—though the permit would include as salvage and rescue operations as part of the allotted take (i.e., during some of the activities, listed fish would be collected and transported downriver to improve their survival). In addition, the IDFG is asking to lethally take a small number of juvenile SR sockeye and spring/summer chinook salmon during portions of the research.

The research has many purposes and would benefit listed SR salmon in different ways. However, in general, the purpose of the research is to determine the distribution, abundance, and productivity of anadromous and resident fish stocks; measure the efficacy of harvest management strategies and the impact of proposed or existing habitat alteration projects; and monitor natural production levels, salmonid health, and the effectiveness of supplementation efforts. The research would benefit listed salmon by helping resource managers tailor land-altering activities (e.g., timber harvest, road building) to the needs of the fish; set harvest regimes so that they have minimal impacts on listed populations; prioritize projects in a way that gives maximum benefit to listed species; and design strategies and activities to help recover them; and outrightly rescue them in some instances.

Permit 1134

The Columbia River Inter Tribal Fish Commission (CRITFC) is requesting a 5-year permit covering five study projects that, among them, would annually take adult and juvenile threatened SR fall chinook salmon; adult and juvenile threatened SR spring/summer chinook salmon (natural and artificially propagated); and adult and juvenile threatened SR steelhead in the Snake River basin. The original permit was in place for five years (63 FR 30199) with one amendment (67 FR 43909); it expired on December 31, 2002. Over the years, there have been some changes in the research and they are reflected in this application (e.g., the aforementioned amendment and some reallocation of research activities and their associated take to other permits), nonetheless, the projects proposed are largely continuations of ongoing research. They are: Project 1—Adult Spring/summer and Fall Chinook Salmon and Summer Steelhead Ground and Aerial Spawning Ground Surveys; Project 2—Cryopreservation of Spring/summer Chinook Salmon and Summer Steelhead Gametes; Project 3—Adult Chinook Salmon Abundance Monitoring Using Video Weirs, Acoustic Imaging, and PIT tag Detectors in the South Fork Salmon River; Project 4—Snorkel, Seine, Minnow Traps, and Electrofishing Surveys and Collection of Juvenile Chinook Salmon and Steelhead; and Project 5—Juvenile Anadromous Salmonid Emigration Studies Using Rotary Screw Traps. Under these tasks, listed adult and juvenile salmon would be variously (a) observed/harassed during fish population and production monitoring surveys; (b) captured (using seines, trawls, traps, hook-and-line angling equipment, and electrofishing equipment) and anesthetized; (c) sampled for biological information and tissue samples, (d) PIT-tagged or tagged with other identifiers, (e) and released. The CRITFC does not intend to kill any of the fish being captured, but a small percentage may die as a result of the research activities.

The research has many purposes and would benefit listed salmon and steelhead in different ways. However, in general, the studies are part of ongoing efforts to monitor the status of listed species in the Snake River basin and to use that data to inform decisions about land- and fisheries management actions and to help prioritize and plan recovery measures for the listed species. Under the proposal, the studies would continue to benefit listed species by generating population abundance estimates, allowing comparisons to be made between naturally reproducing populations and those being supplemented with hatchery fish, and helping preserve listed salmon and steelhead genetic diversity.

Permit 1140

The Northwest Fisheries Science Center (NWFSC), NMFS in Seattle, Washington (WA) requests a 5-year permit for three studies that would annually take a number of species but only one of the studies—Study 1—would take species of concern to this Opinion: juvenile endangered SR sockeye salmon; juvenile threatened naturally-produced and artificially-propagated SR S/S chinook salmon; juvenile threatened SR fall chinook salmon; and juvenile , threatened SR steelhead. Under Study 1, the NWFSC would take listed juvenile salmon and steelhead while conducting research that will assess the relationship between environmental variables, selected anthropogenic stresses, and bacterial and parasitic pathogens on disease-induced mortality in juvenile salmon in selected coastal estuaries and nearshore areas in Oregon and Washington. In addition, the NWFSC would gather additional site-specific information in the Lower Columbia River to (1) determine contaminant concentrations in fish, (2) understand bioaccumulation in juvenile salmon and determine site-specific factors, (3) analyze for the presence of physiological biomarkers, and to (4) investigate the presence of indicators of exposure to environmental estrogens. The NWFSC would collect samples with seines or high speed rope trawls, and requests authorization to lethally take salmon for pathogen prevalence and intensity, biochemical composition, histopathological attributes, and stomach content analyses.

The research would benefit the species of concern in a number of ways. The information gathered would help researchers understand a great deal more about juvenile salmonid survival in the estuarine environment. In particular, it would help them determine which environmental and anthropogenic stressors are having the biggest impacts on salmonid survival. This information could, in turn, be used in a variety of ways to reduce stress on the outmigrating fish.

Permit 1152

The Oregon Department of Fish and Wildlife (ODFW) is requesting a 5-year permit covering six projects that, among them, would annually take juvenile and adult threatened SR spring/summer chinook salmon (natural and artificially propagated) and adult and juvenile threatened SR steelhead in Northeast Oregon. The original permit was in place for five years (63 FR 49336) with one modification (67 FR 34909); it expired on December 31, 2002. Over the years, there have been some changes in the research (e.g., the aforementioned modification) and they are reflected in this application. Nonetheless, the projects proposed are largely continuations of ongoing research. They are: Project 1—Northeast Oregon Spring Chinook Salmon Spawning Ground Surveys; Project 2—Spring Chinook Salmon and Steelhead Life History in the Grande Ronde River Basin; Project 3—Residual hatchery Steelhead Monitoring in Northeast Oregon; Project 4—Passage and Irrigation Screening; Project 5—Bull Trout Migratory patterns, Population Structure, and Abundance in the Blue Mountains Province (does not target listed species but would indirectly take them); and Project 6—Fish Distribution and Abundance Monitoring in Northeast Oregon. Under these tasks, listed adult and juvenile salmon would be variously (a) observed/harassed during fish population and production monitoring surveys; (b) captured (using seines, trawls, traps, hook-and-line angling equipment, and electrofishing equipment) and anesthetized; (c) sampled for biological information and tissue samples, (d) PIT-tagged or tagged with radio transmitters or other identifiers, (e) and released. The ODFW does not intend to kill any of the fish being captured, but a small percentage may die as an indirect result of the research activities.

The research has many purposes and would benefit listed salmon and steelhead in different ways. In general, the purpose of the proposed research is to gather information on the natural production, distribution, survival, resource and habitat use, and genetic and life history characteristics of listed chinook salmon and steelhead in Northeast Oregon. If allowed to continue, the research activities would provide ongoing benefits to listed salmon and steelhead by helping resource managers (a) guide recovery actions, (b) prioritize habitat protection and restoration projects, (c) monitor ongoing management activities, (d) evaluate supplementation efforts, and (d) provide effective screening on water diversions that might otherwise entrain, strand, and kill listed fish.

Permit 1156

The U.S. Environmental Protection Agency (EPA) in Corvallis, Oregon (OR) is requesting a 5-year permit to annually take a number of species but the only ones of concern to this Opinion are adult and juvenile threatened SR spr/sum chinook salmon, adult and juvenile threatened SR fall chinook salmon, and adult and juvenile threatened SR steelhead. The research is designed to assess species status and trends in randomly-selected river systems in Oregon, Washington, and Idaho. The EPA intends to conduct annual surveys for fish, macroinvertebrate, algae, and microbial assemblages as well as physical and chemical habitat conditions. Listed fish will be captured by electrofishing (using backpack or raft-mounted gear), sampled for biological information, and released.

The research will benefit the listed species by providing baseline information about water quality in the study areas and will also support enforcement of the Clean Water Act in those river systems where listed fish are present. Dynamac Corporation, U.S. Geological Survey Biological Resources Division, Idaho Department of Environmental Quality, and Washington Department of Ecology will be cooperators in the proposed EPA research. The EPA requests the cooperators' biologists be authorized as agents of the EPA in conducting the research.

Permit 1194

The NWFSC in Seattle, Washington is requesting a five-year permit to annually take adult endangered UCR steelhead, adult endangered UCR spring chinook salmon, and adult threatened SR spring/summer chinook salmon during a study designed to evaluate passive integrated transponder tag (PIT) interrogation systems at Bonneville Dam on the Columbia River. Permit 1119 has been in place for nearly five years, but it is due to expire on December 31, 2003. The NWFSC proposes to continue to capture (using traps at Bonneville Dam), anesthetize, tag, release, and monitor with video cameras adult fish.

The objectives of the study are to evaluate the ability of the prototype tag detection systems to detect PIT-tagged adult salmon passing through the facility and evaluate the effects of the detection system on adult behavior as they approach and pass through it. The NWFSC does not intend to kill any of the fish being captured, but a small percentage may die as an unintended result of the research activities.

Permit 1205

The Oregon Department of Environmental Quality (ODEQ) in Portland, OR requests a 5-year permit for annual take of juvenile threatened spr/sum chinook salmon, SR fall chinook salmon, and SONCC coho salmon associated with research designed to assess the condition of randomly selected streams in Southwestern and Northeastern Oregon. The research involves stream vertebrate surveys that are part of a monitoring program that evaluates the chemical, biological, and habitat conditions of streams on a regional basis. ODEQ's research implements the Oregon Plan and is coordinated with the Oregon Department of Fish and Wildlife and the EPA. ODEQ would capture listed juvenile salmonids using backpack electrofishing, sample them for biological information, and release them. The research will benefit the listed species by providing baseline information to support enforcement of the Clean Water Act in freshwater river systems where listed fish are present.

Permit 1290-Modification 1

The NWFSC in Seattle, Washington (WA) is requesting a modification to permit 1290 that would allow them to increase the number of fish taken in their research. Under the modification, the NWFSC would increase their annual take of juvenile threatened SR spring/summer chinook salmon (natural and artificially propagated); threatened SR fall chinook salmon; endangered UCR chinook salmon (natural and artificially propagated); threatened LCR chinook salmon; endangered UCR steelhead (natural and artificially propagated); and threatened MCR steelhead during the course of research being conducted in the Columbia River estuary. The NWFSC proposes to capture, handle, and release listed salmonids, and while most of the fish would be unharmed, some would die during the course of the research and a small number of them would be intentionally killed. Purse seines or beach seines would be the primary capture method. Captured fish would be anesthetized, identified, and measured.

The purpose of the research is to evaluate the importance of the Columbia River estuary to baitfish populations and salmonid marine survival, and the role of disease as a factor affecting survival of juvenile salmonids in the estuarine and marine environment. The research would benefit listed salmonids by contributing information on the extent to which baitfish populations and diseases affect the growth and survival of juvenile salmonids in the estuarine and early ocean environments.

Permit 1291—Modification 2

The United States Geological Survey (USGS) is requesting a modification to Permit 1291 that would allow them to use McNary Dam on the Columbia River as a possible alternate collection point for some of the fish used in their research. Under the modification, the USGS would annually take juvenile threatened SR spring/summer chinook salmon (natural and artificially propagated); threatened SR fall chinook salmon, endangered UCR chinook salmon (natural and artificially propagated); threatened LCR chinook salmon; threatened UWR chinook salmon; threatened LCR steelhead; threatened MCR steelhead; endangered UCR steelhead (natural and artificially propagated); threatened SR steelhead; and endangered SR sockeye salmon at up to three dams on the Columbia River. Under the modification, the listed juvenile fish would be either (1) captured by Smolt Monitoring Program (SMP) personnel at John Day Dam (and, if necessary at Bonneville and McNary Dams) handled, and released or (2) captured by SMP personnel and given to USGS personnel and implanted with radio transmitters, transported, held for as long as 24 hours, released, and tracked electronically. The USGS requests that SMP personnel be allowed to act as agents of the USGS under the proposed permit. The USGS does not intend to kill any of the fish being captured, but a small percentage may die as a result of the research activities.

The purpose of the research is to monitor (using radio telemetry) juvenile fish movement, distribution, behavior, and survival in the Columbia River. The research would benefit listed salmonids by providing information on spill effectiveness, forebay residence times, and guidance efficiency under various flow regimes that would allow Federal resource managers to adjust bypass/collection structures and thereby optimize downriver migrant survival at the hydropower projects.

Permit 1322—Modification 2

The NWFSC is requesting that NMFS modify Permit 1322 to increase the annual number of listed fish taken in their research. Under the modification, the NWFSC would increase their annual take of juvenile threatened SR spring/summer chinook salmon (natural and artificially propagated); threatened SR fall chinook salmon; endangered UCR chinook salmon (natural and artificially propagated); threatened LCR chinook salmon, threatened UWR chinook salmon, and threatened CR chum salmon while conducting research in the Columbia River estuary. The NWFSC proposes to capture, handle, and release listed salmonids, and while most of the fish would be unharmed, some would die during the course of the research and a small number of them would be intentionally killed. Purse seines, trap nets, and beach seines would be used to capture the fish. Captured fish would be anesthetized, identified, sampled for tissues, and measured. Some fish would be sacrificed to confirm species identification, catch composition, food habits, and timing of estuarine entry. The NWFSC is also requesting an increase in the number of fish that may unintentionally be killed during the research.

The purposes of the research are to (1) determine the presence and abundance of fall and spring chinook salmon, coho salmon, and chum salmon in the estuary and Lower Columbia River; (2) determine the relationship between juvenile salmon and Lower Columbia River estuarine habitat; and (3) obtain information about flow change, sediment input, and habitat availability for the development of a numerical model. The research would benefit listed fish by serving as a basis for estuarine restoration and preservation plans. The NWFSC requests authorization to transfer fish tissue samples to the University of Washington, College of Ocean and Fisheries, School of Fisheries and Aquatic Sciences; Oregon State University, Hatfield Marine Science Center; and Washington Department of Fish and Wildlife.

Permit 1366—Modification 1

The Oregon Cooperative Fish and Wildlife Research Unit (OCFWRU) and the Idaho Cooperative Fish and Wildlife research Unit (ICFWRU) are requesting a five-year permit covering four studies that, among them, would annually take juvenile threatened SR fall chinook salmon; juvenile threatened SR spring/summer chinook salmon (natural and artificially propagated); juvenile endangered UCR spring chinook salmon (natural and artificially propagated), juvenile threatened LCR chinook salmon; juvenile endangered UCR steelhead (natural and artificially propagated); juvenile threatened SR steelhead; and adult and juvenile endangered SR sockeye salmon at various dams on the Columbia and Snake Rivers. The research is largely a continuation of four ongoing studies (with some alteration in take numbers). They are: Study 1—Evaluation of Comparative Survival of In-river Passage and Multiple Bypassed Juvenile Salmon; Study 2—Evaluation of Delayed Mortality in the Near-ocean Environment Following Passage Through the Columbia river Hydropower System; Study 3—Evaluation of Survival and Adult Return Rate of Transported Juvenile Salmon Compared to In-river Migrating Fish; Study 4—Evaluation of Migration and Survival of Juvenile Salmonids Following Transportation. Under these studies, juvenile listed salmon would be variously (a) captured using lift nets or dipnets at the dams (or acquired from Columbia River Smolt Monitoring Program or NMFS personnel at Bonneville Dam), (b) sampled for biological information or tagged with radiotransmitters, and (c) released.

The research has many purposes and would benefit listed salmon and steelhead in different ways. In general, the purpose of the research is to compare biological and physiological indices of wild and hatchery juvenile fish exposed to stress during bypass, collection, and transportation activities at the dams. The research will benefit the listed species by helping determine what effects the dams and their associated structures and management activities have on the outmigrating salmonids and using that information modify those factors in ways that increase salmonid survival.

Permit 1379

The Columbia River Inter Tribal Fish Commission (CRITFC) is requesting a five-year permit covering three study projects that, among them, would annually take adult and juvenile threatened SR fall chinook salmon; adult and juvenile threatened SR spr/sum chinook salmon (natural and artificially propagated); juvenile endangered UCR spring chinook salmon (natural and artificially propagated), adult threatened LCR chinook salmon; adult and juvenile endangered UCR steelhead (natural and artificially propagated); adult and juvenile threatened SR steelhead; and adult and juvenile endangered SR sockeye salmon at various points in the Columbia, Wenatchee, and Methow Rivers in Washington State. The research was originally conducted under Permit 1134, which was in place for five years (63 FR 30199) with one amendment (67 FR 43909); it expires on June 30, 2003. Over the years, there have been some changes in the research and they are reflected in this proposal (e.g., the aforementioned amendment and some reallocation of research activities and their associated take to this and other permits), nonetheless, the proposed projects are largely continuations of ongoing research. They are: Project 1—Juvenile Upriver Bright Fall Chinook Sampling at the Hanford Reach (does not directly target a listed species but would indirectly take them); Project 2—Adult Chinook, Sockeye, and Coho Sampling at Bonnevile Dam; and Project 3—Adult Sockeye Sampling at Tumwater Dam, Wenatchee River (does not directly target a listed species but would indirectly take them). Under these tasks, listed adult and juvenile salmon would be variously (a) captured (using seines, trawls, traps, hook-and-line angling equipment, and electrofishing equipment) and anesthetized; (b) sampled for biological information and tissue samples, (c) or tagged with radio transmitters or other identifiers, (e) and released.

The research has many purposes and would benefit listed salmon and steelhead in different ways. In general, the purpose of the research is to gain current information on the status and productivity of various fish populations, collect data on migratory and exploitation (harvest) patterns, and develop baseline information on various population and habitat parameters in order to guide salmonid restoration strategies—all of which are of use on their own, but most of which are being done in accordance with specific requirements of the U.S.– Canada Pacific Salmon Treaty. The research would continue to benefit listed fish by helping managers set in-river and ocean harvest regimes so that they have minimal impacts on listed populations, prioritize projects in a way that gives maximum benefit to listed species, and design strategies and activities to help recover them. The CRITFC does not intend to kill any of the fish being captured, but a small percentage may die as an unintended result of the research activities.

Permit 1403

The NWFSC is requesting a five-year permit to annually take juvenile threatened SR spring/summer chinook salmon (natural); juvenile threatened SR steelhead; and juvenile threatened MCR steelhead at various places in the Salmon River subbasin, Idaho, and the John Day River subbasin in Oregon. The research encompasses two studies: Assessment of Three Alternative Methods of Nutrient Enhancement (Salmon Carcasses, Carcass Analogues, and Nutrient Pellets) on Biological Communities in Columbia River Tributaries, and Utilization of Nutrients from Spawning Salmon by Juvenile Chinook Salmon and Steelhead in the Columbia and Snake River Basins. Under these studies, the fish would variously be (a) captured (using seines, nets, traps and, possibly, electrofishing equipment) and anesthetized; (b) measured and weighed; (c) held for a time in enclosures in the stream from which they are captured; and (d) released. Both projects call for some juvenile listed fish to be intentionally killed as part of the research. It is also likely that a small percentage of the fish being captured would unintentionally be killed during the process. In addition, tissue samples would be taken from adult carcasses found on streambanks.

The research has many purposes and would benefit listed salmon and steelhead in different ways. In general, the purpose of the research is to (a) learn how salmonids acquire nutrients from the bodies of dead spawners and test three methods of using those nutrients to increase growth and survival among naturally produced salmonids and (b) determine the extent to which juvenile steelhead and chinook use marine-derived nutrients and learn more about the relationships between juvenile salmonid body size, population density, and nutrient uptake. The research will benefit the fish by helping managers use nutrient enhancement techniques to help recover listed salmonid populations. Moreover, managers will be able to gain a broader understanding of the role marine-derived nutrients play in ecosystem health as a whole. This, in turn, will help inform management decisions and actions intended to help salmon recovery in the future.

Permit 1406

The NWFSC is requesting a five-year permit to annually take juvenile (and precocious male) threatened SR spring/summer chinook salmon (naturally produced) and juvenile threatened SR steelhead at various places in the Salmon River drainage in Idaho, at Little Goose Dam on the lower Snake River, and at multiple subbbasins in Northeast Oregon, Southeast Washington, and Idaho—including the Clearwater and Grande Ronde Rivers. The research is largely a continuation of two long-term, ongoing studies formerly conducted under permits 852 and 1056; the studies have been in place for more than 10 years. They are: Monitoring the Migrations of wild Snake River Spring/summer Chinook Salmon Smolts and Monitoring and Evaluating the Genetic Characteristics of Supplemented Salmon and Steelhead. Under these studies, the listed fish would be variously captured (using seines, dip nets, and electrofishing), re-captured at a smolt bypass facility, anesthetized, tagged with PIT tags or otherwise marked, tissue sampled, weighed, measured, and released. Both projects call for some juvenile listed fish to be intentionally killed as part of the research. It is also likely that a small percentage of the fish being captured would unintentionally be killed during the process.

The research has many purposes and would benefit listed salmon and steelhead in different ways. In general, the purpose of the research is to continue monitoring juvenile out migration behavior and the effects of supplementation among steelhead spring/summer chinook salmon populations in Idaho. The research will benefit the fish by continuing to supply managers with the information they need to (a) budget water releases at hydropower facilities in ways that will help protect migrating juveniles, and (b) use hatchery programs to conserve listed species.

Permit 1410

The NWFSC in Seattle, Washington (WA) requests a 5-year permit for annual take of adult and juvenile listed fish. The NWFSC proposes to investigate the distribution, abundance, condition and health of juvenile salmon in relation to physical and biological oceanographic conditions in the Columbia River plume and surrounding ocean environment to better understand factors controlling estuarine and marine survival. The study will provide information to help predict and forecast survival potential as a function of easily measured indices of plume and ocean conditions. Further, the information will help hydropower operators develop a set of hydropower management scenarios that could benefit survival, growth, and health of juvenile salmon by changing the dynamics of the Columbia River plume. Listed fish will be collected with purse seines and trawl nets, sampled for biological data, and released. The NWFSC also requests authorization to lethally take salmon for endocrine assessments, genetic stock identification, pathogen prevalence and intensity, otolith and stomach content analysis, and histopathological attributes.

Permit 1421

The USFWS in Vancouver, Washington is requesting a three-year permit to annually take adult and juvenile endangered SR sockeye salmon; adult and juvenile endangered UCR spring chinook salmon (natural and artificially propagated); adult and juvenile endangered UCR steelhead (natural and artificially propagated); adult and juvenile threatened SR fall chinook salmon; adult and juvenile threatened SR spring/summer chinook salmon (natural and artificially propagated); adult and juvenile threatened SR steelhead; adult and juvenile threatened MCR steelhead; adult and juvenile threatened LCR chinook salmon; adult and juvenile threatened LCR steelhead; and adult and juvenile threatened CR chum salmon during the course of a study in the Franz Lake National Wildlife Refuge on the Lower Columbia River. The USFWS proposes to capture (using boat and backpack electrofishing, fyke nets, and minnow traps), anesthetize, measure, check for tags, mark, sample for stomach content, and release listed salmonids.

The objectives of the study are to (1) document fish species in the refuge, (2) evaluate fish distribution relative to habitat features, and (3) describe fish diets in the refuge. The study will be coordinated with a mosquito control study conducted by the Oregon Cooperative Fish and Wildlife Research Unit. The study will benefit listed fish by generating information on the effects of mosquito control on salmonids and salmonid prey species, and the spacial and temporal relations among fish distribution, fish diets, and areas typically treated to control mosquitos. The USFWS does not intend to kill any of the listed fish being captured, but a small percentage may die as an unintended result of the research activities.

The Action Areas

SR Sockeye

The action area is defined as the geographic extent of all direct and indirect effects of a proposed agency action [50 CFR 402.02 and 402.14(h)(2)]. For the purposes of this opinion—and for research activities targeting endangered SR sockeye salmon—the action area is the Stanley River subbasin in Idaho, along with the rest of the species' designated critical habitat (NOAA 1993b). The action area for the species includes river reaches presently or historically accessible (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams). Included are adjacent riparian zones and mainstem river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the confluence of the Columbia and Snake Rivers; all Snake River reaches from the confluence of the Columbia River upstream to the confluence of the Salmon River; all Salmon River reaches from the confluence of the Snake River upstream to Alturas Lake Creek; Stanley, Redfish, Yellow Belly, Pettit, and Alturas Lakes (including their inlet and outlet creeks); and Alturas Lake Creek and that portion of Valley Creek between Stanley Lake Creek and the Salmon River. Watersheds containing spawning and rearing habitat for this ESU comprise approximately 510 square miles in Idaho. The watersheds lie partially or wholly within Blaine and Custer counties.

SR Spr/sum chinook

The action area for threatened SR spring/summer chinook salmon is the mainstem Snake River, the Tucannon River subbasin, the Grande Ronde River subbasin, the Imnaha River subbasin, the Salmon River subbasin, and includes the species' designated critical habitat (NOAA 1993b and NOAA 1999). The action area for the species includes river reaches presently or historically accessible (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams). Included are adjacent riparian zones, as well as mainstem river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the confluence of the Columbia and Snake Rivers and all Snake River reaches from the confluence of the Columbia River upstream to Hells Canyon Dam. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 22,390 square miles in Idaho, Oregon, and Washington. The following counties lie partially or wholly within these basins: Idaho - Adams, Blaine, Custer, Idaho, Lemhi, Lewis, Nez Perce, and Valley; Oregon - Baker, Umatilla, Union, and Wallowa; Washington - Adams, Asotin, Columbia, Franklin, Garfield, Walla Walla, and Whitman.

SR Fall Chinook

The action area for threatened SR fall chinook salmon is the mainstem Snake River, the Tucannon River subbasin, the Grande Ronde River subbasin, the Imnaha River subbasin, the Salmon River subbasin, the Clearwater River subbasin, and includes the species' designated critical habitat (NOAA 1993b). The action area for the species includes river reaches presently or historically accessible (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams). Included are adjacent riparian zones, as well as mainstem river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the confluence of the Columbia and Snake Rivers; the Snake River including all river reaches from the confluence of the Columbia River upstream to Hells Canyon Dam; the Palouse River from its confluence with the Snake River upstream to Palouse Falls; the Clearwater River from its confluence with the Snake River upstream to its confluence with Lolo Creek; and the North Fork Clearwater River from its confluence with the Clearwater River upstream to Dworshak Dam. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 13,679 square miles in Idaho, Oregon, and Washington. The following counties lie partially or wholly within these basins: Idaho - Adams, Clearwater, Idaho, Latah, Lemhi, Lewis, and Nez Perce; Oregon - Baker, Union, and Wallowa; Washington - Adams, Asotin, Columbia, Franklin, Garfield, Walla Walla, and Whitman.

SR Steelhead

The action area for threatened SR steelhead is the Snake River Basin of Idaho, southeast Washington, and northeast Oregon. The action area for the species includes river reaches presently or historically accessible in the Snake River and its tributaries in Idaho, Oregon, and Washington. Included are mainstem river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the confluence of the Columbia and Snake Rivers. Excluded are tribal lands and areas above specific dams (such as Dworshak and Hells Canyon Dams) and areas above longstanding, naturally impassable barriers (i.e., Napias Creek Falls and other natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 29,282 square miles in Idaho, Oregon, and Washington. The following counties lie partially or wholly within these basins: Idaho - Adams, Blaine, Boise, Clearwater, Custer, Idaho, Latah, Lemhi, Lewis, Nez Perce, and Valley; Oregon - Baker, Umatilla, Union, and Wallowa; Washington - Adams, Asotin, Columbia, Franklin, Garfield, Walla Walla, and Whitman. More detailed habitat information (i.e., specific watersheds, migration barriers, habitat features, and special management considerations) for SR steelhead can be found in the February 16, 2000, *Federal Register* notice designating critical habitat (65 FR 7764). It should be noted, however, that the critical habitat designation for SR steelhead was vacated and remanded to NMFS for new rulemaking pursuant to a court order in May of 2002. In the absence of a new rule designating critical habitat for SR steelhead, this consultation will evaluate the effects of the proposed actions on the species' habitat to determine whether those actions are likely to jeopardize the species' continued existence.

STATUS OF SPECIES UNDER THE ENVIRONMENTAL BASELINE

In order to describe a species' status, it is first necessary to define precisely what "species" means in this context. Traditionally, one thinks of the ESA listing process as pertaining to entire taxonomic species of animals or plants. While this is generally true, the ESA also recognizes that there are times when the listing unit must necessarily be a subset of the species as a whole. In these instances, the ESA allows a "distinct population segment" (DPS) of a species to be listed as threatened or endangered. SR steelhead, sockeye, and fall and spr/sum chinook are just such DPSs and, as such, are for all intents and purposes considered "species" under the ESA.

NMFS developed the approach for defining salmonid DPSs in 1991 (Waples 1991). It states that a population or group of populations is considered distinct if they are "substantially reproductively isolated from conspecific populations," and if they are considered "an important component of the evolutionary legacy of the species." A distinct population or group of populations is referred to as an evolutionarily significant unit (ESU) of the species. Hence, SR sockeye are an ESU of *O. nerka*, SR spr/sum and fall chinook are ESUs of *O. tshawytscha*, and SR steelhead constitute an ESU of the species *O. mykiss.*

The SR sockeye salmon ESU was listed as endangered on November 20, 1991 (NOAA 1991). It includes populations of sockeye salmon from the Snake River Basin, Idaho (extant populations occur only in the Salmon River subbasin). Under NMFS' interim policy on artificial propagation (NOAA 1993a), the progeny of fish from a listed population that are propagated artificially are considered part of the Listed species and are protected under ESA. Thus, although not specifically designated in the 1991 listing, SR sockeye salmon produced in IDFG's captive broodstock program are included in the Listed ESU. Given the dire status of the wild population under any criteria (16 wild and 264 hatchery-produced adult sockeye returned to the Stanley basin between 1990 and 2000), NMFS considers the captive broodstock and its progeny essential for recovery. In 2001, 36 adult sockeye were counted at Lower Granite Dam (FPC, 2002). Critical habitat was designated for SR sockeye salmon on December 28, 1993 (NOAA 1993b).

The SR spring/summer chinook salmon ESU, listed as threatened on April 22, 1992 (NOAA 1992), includes all natural-origin populations in the Tucannon, Grande Ronde, Imnaha, and Salmon Rivers. Some or all of the fish returning to several of the hatchery programs are also listed including those returning to the Tucannon River, Imnaha River, and Grande Ronde River hatcheries, and to the Sawtooth, Pahsimeroi, and McCall hatcheries on the Salmon River. Critical habitat was designated for SR spring/summer chinook salmon on December 28, 1993 (NOAA 1993b), and was revised on October 25, 1999 (NOAA 1999).

The SR fall chinook salmon ESU, listed as threatened on April 22, 1992 (NOAA 1992), includes all natural-origin populations of fall chinook in the mainstem Snake River and several tributaries including the Tucannon, Grande Ronde, Salmon, and Clearwater Rivers. Fall chinook salmon from the Lyons Ferry Hatchery are included in the ESU but are not listed. Critical habitat was designated for SR fall chinook salmon on December 28, 1993 (NOAA 1993b).

The SR steelhead ESU, listed as threatened on August 18, 1997 (62 FR 43937), includes all naturally spawned populations of steelhead (and their progeny) in streams in the Snake River Basin of southeast Washington, northeast Oregon, and Idaho. Steelhead from Dworshak, Oxbow, and Imnaha National Fish Hatcheries (NFH) are included in this ESU, but they are not listed under the ESA.

The SR fish were listed because NMFS determined that a number of factors—both environmental and demographic—had caused them to decline to the point where they were likely to become extinct within the foreseeable future. These factors for decline affect SR sockeye, chinook, and steelhead biological requirements at every life stage and they arise from a number of different sources. This section of the Opinion explores those effects and defines the context within which they take place.

Species/ESU Life History

<u>Snake River Sockeye Salmon</u>

Snake River sockeye salmon adults enter the Columbia River primarily during June and July. Arrival at Redfish Lake, which now supports the only remaining run of Snake River sockeye salmon, peaks in August, and spawning occurs primarily in October (Bjornn *et al.* 1968). Eggs hatch in the spring between 80 and 140 days after spawning. Fry remain in the gravel for three to five weeks, emerge from April through May, and move immediately into the lake. Once there, juveniles feed on plankton for one to three years before they migrate to the ocean (Bell 1986). Migrants leave Redfish Lake during late April through May (Bjornn *et al.* 1968) and travel almost 900 miles to the Pacific Ocean. Smolts reaching the ocean remain inshore or within the influence of the Columbia River plume during the early summer months. Later, they migrate through the northeast Pacific Ocean (Hart 1973, Hartt and Dell 1986). Snake River sockeye salmon spend two to three years in the Pacific Ocean and return in their fourth or fifth year of life.

Historically, Snake River sockeye salmon were produced in the Salmon River subbasin in Alturas, Pettit, Redfish, and Stanley lakes and in the South Fork Salmon River subbasin in Warm Lake. Sockeye salmon may have been present in one or two other Stanley basin lakes (Bjornn *et al.* 1968). Elsewhere in the Snake River Basin, sockeye salmon were produced in Big Payette Lake on the North Fork Payette River and in Wallowa Lake on the Wallowa River (Evermann 1895, Toner 1960, Bjornn *et al.* 1968, Fulton 1970).

Chinook Salmon

The chinook salmon is the largest of the Pacific salmon. The species' distribution historically ranged from the Ventura River in California to Point Hope, Alaska, in North America, and in northeastern Asia from Hokkaido, Japan, to the Anadyr River in Russia (Healey 1991). Additionally, chinook salmon have been reported in the Mackenzie River area of northern Canada (McPhail and Lindsey 1970). Of the Pacific salmon, chinook salmon exhibit the most diverse and complex life history strategies. Healey (1986) described 16 age categories for chinook salmon, combinations of seven total ages with three possible freshwater ages. This level of complexity is roughly comparable to that seen in sockeye salmon, although the latter species has a more extended freshwater residence period and uses different freshwater habitats (Miller and Brannon 1982, Burgner 1991). Gilbert (1912) initially described two generalized freshwater life-history types: "stream-type" chinook salmon, which reside in freshwater for a year or more following emergence, and "ocean-type" chinook salmon, which migrate to the ocean within their first year. Healey (1983, 1991) has promoted the use of broader definitions for ocean-type and stream-type to describe two distinct races of chinook salmon. Healey's approach incorporates life-history traits, geographic distribution, and genetic differentiation and provides a valuable frame of reference for comparisons of chinook salmon populations. In this instance, SR fall chinook salmon are considered "ocean-type" chinook and SR spr/sum chinook salmon are considered "stream-type."

SR Fall Chinook Salmon

Adult SR fall chinook salmon enter the Columbia River in July and migrate into the Snake River from August through October. Fall chinook salmon generally spawn from October through November, and fry emerge from March through April. Downstream migration generally begins within several weeks of emergence (Becker 1970, Allen and Meekin 1973), and juveniles rear in backwaters and shallow water areas through mid-summer before smolting and migrating to the ocean—thus they exhibit an ocean-type juvenile history. Once in the ocean, they spend one to four years (though usually three years) before beginning their spawning migration. Fall returns in the Snake River system are typically dominated by 4-year-old fish.

SR Spr/sum Chinook Salmon

The present range of spawning and rearing habitat for naturally spawned SR spring/summer chinook salmon is primarily limited to the Salmon, Grande Ronde, Imnaha, and Tucannon River subbasins. Most SR spring/summer chinook salmon enter individual subbasins from May through September. Juvenile SR spring/summer chinook salmon emerge from spawning gravels from February through June (Peery and Bjornn 1991). Typically, after rearing in their nursery streams for about 1 year, smolts begin migrating seaward in April and May (Bugert *et al.* 1990, Cannamela 1992). After reaching the mouth of the Columbia River, spring/summer chinook salmon probably inhabit nearshore areas before beginning their northeast Pacific Ocean migration, which lasts two to three years.

<u>Steelhead</u>

Steelhead can be divided into two basic run types based on their level of sexual maturity at the time they enter fresh water and the duration of the spawning migration (Burgner et al. 1992). The stream-maturing type, or summer steelhead, enters fresh water in a sexually immature condition and requires several months in fresh water to mature and spawn. The ocean-maturing type, or winter steelhead, enters fresh water with well-developed gonads and spawns relatively shortly after river entry (Barnhart 1986). Variations in migration timing exist between populations. Some river basins have both summer and winter steelhead, others only have one run type. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death. However, it is rare for steelhead to spawn more than twice before dying, and most that do so are females (Nickelson *et al.* 1992). Iteroparity is more common among southern steelhead populations than northern populations (Busby *et al.* 1996). Multiple spawnings for steelhead range from three percent to 20 percent of some of the runs in Oregon coastal streams. Steelhead spawn in cool, clear streams with suitable gravel size, depth, and current velocity. Intermittent streams may also be used for spawning (Barnhart 1986, Everest 1973).

SR Steelhead

The Snake River steelhead ESU is distributed throughout the Snake River drainage system, including tributaries in southwest Washington, eastern Oregon and north/central Idaho (NMFS 1996). Snake River steelhead migrate a substantial distance from the ocean (up to 1,500 km) and use high elevation tributaries (typically 1,000-2,000 m above sea level) for spawning and juvenile rearing. Snake River steelhead occupy habitat that is considerably warmer and drier (on an annual basis) than other steelhead ESUs. Snake River basin steelhead are generally classified as summer run, based on their adult run timing patterns. Summer steelhead enter the Columbia River from late June to October. After holding over the winter, summer steelhead spawn during the following spring (March to May). Managers classify up-river summer steelhead runs into to groups based primarily on ocean age and adult size upon return to the Columbia River. A-run steelhead are predominately age-1 ocean fish while B-run steelhead are larger, predominated by age-2 ocean fish.

Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death. However, it is rare for steelhead to spawn more than twice before dying, and most that do so are females (Nickelson *et al.* 1992). Iteroparity is more common among southern steelhead populations than northern populations (Busby *et al.* 1996). Multiple spawnings for steelhead range from 3 percent to 20 percent of runs in Oregon coastal streams.

Overview—Status of the Species in the Action Area

To determine a species' status under extant conditions (usually termed "the environmental baseline"), it is necessary to ascertain the degree to which the species' biological requirements are being met at that time and in that action area. For the purposes of this consultation, SR sockeye, chinook, and steelhead biological requirements are expressed in two ways: Population parameters such as fish numbers, distribution, and trends throughout the action area; and the condition of various essential habitat features such as water quality, stream substrates, and food availability. Clearly, these two types of information are interrelated. That is, the condition of a given habitat has a large impact on the number of fish it can support. Nonetheless, it is useful to separate the species' biological requirements into these parameters because doing so provides a more complete picture of all the factors affecting SR salmonid survival. Therefore, the discussion to follow will be divided into two parts: Species Distribution and Trends; and Factors Affecting the Environmental Baseline.

Species Distribution and Trends

Snake River Sockeye Salmon

Information on the status and distribution of endangered SR sockeye salmon is found in the status review prepared by the Northwest Fisheries Science Center, NMFS (Waples *et al*. 1991a). More recent information on the status and distribution of the sockeye salmon ESU, including hatchery components, is provided in the status review update prepared by the Northwest Fisheries Science Center, NMFS (Gustafson *et al.* 1997), and in the Preliminary Conclusions Regarding the Updated Status of listed ESUs of West Coast Salmon and Steelhead (NMFS 2003). The discussions in these documents are summarized below. Information on critical habitat for endangered SR sockeye salmon is found in the *Federal Register* notice that designates critical habitat for this species (NOAA 1993b).

Escapement of sockeye salmon to the Snake River has declined dramatically in the last several decades, primarily because the construction of hydropower dams made it difficult for sockeye salmon to have access to traditional spawning areas. Adult counts at Ice Harbor Dam declined from 3,170 in 1965 to zero in 1990 (ODFW and WDFW 1999). The Idaho Department of Fish and Game counted adults at a weir in Redfish Lake Creek during 1954 through 1966; adult counts dropped from 4,361 in 1955 to fewer than 500 after 1957 (Bjornn *et al.* 1968). A total of 16 wild sockeye salmon returned to Redfish Lake between 1991 and 1999. During 1999, seven hatchery-produced, age-3 adults returned to the Sawtooth Hatchery. Three of these adults were released to spawn naturally, and four were taken into the IDFG captive broodstock program. In 2000, 257 hatchery-produced, age-4 sockeye salmon returned to the Stanley basin (weirs at the Sawtooth Hatchery and Redfish Lake Creek). Adults numbering 243 were handled and redistributed to Redfish (120), Alturas (52), and Pettit (28) lakes, with the remaining 43 adults incorporated into the IDFG captive broodstock program.

Low numbers of adult Snake River sockeye salmon preclude a quantitative analysis of the status of this ESU. However, because only16 wild and 264 hatchery-produced adult sockeye returned to the Stanley basin between 1990 and 2000, NMFS considers the status of this ESU to be dire by any criteria.

Chinook Salmon

Snake River Spr/Sum Chinook Salmon

Information on the status and distribution of SR spring/summer chinook salmon is found in the status review prepared by the Northwest Fisheries Science Center, NMFS (Matthews and Waples 1991). More recent information on the status and distribution of the chinook salmon ESU, including hatchery components of the respective populations, is provided in the Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California prepared by the West Coast Chinook Salmon Biological Review Team (Myers *et al.* 1998) and the Evaluation of the Status of Chinook and Chum Salmon and Steelhead Hatchery Populations for ESUs Identified in Final Listing Determinations prepared by the Conservation Biology Division of the NWFSC (NMFS 1999), and in the Preliminary Conclusions Regarding the Updated Status of listed ESUs of West Coast Salmon and Steelhead (NMFS 2003). The discussions in these documents are summarized below. Information on critical habitat for threatened SR spring/summer chinook salmon is found in the *Federal Register* notice that designates critical habitat for this species (NOAA 1993b) and the *Federal Register* notice that revised the critical habitat designation for the species (NOAA 1999).

Direct estimates of annual runs of historical spring/summer chinook to the Snake River are not available. Chapman (1986) estimated that the Columbia River produced 2.5 million to 3.0 million spring and summer chinook per year in the late 1800s. Total spring and summer chinook production from the Snake Basin contributed a substantial proportion of those returns; the total annual production of Snake River spring and summer chinook may have been in excess of 1.5 million adult returns per year (Matthews and Waples 1991). Returns to Snake River tributaries had dropped to roughly 100,000 adults per year by the late 1960s (Fulton 1968). Increasing hatchery production contributed to subsequent years returns, masking a continued decline in natural production.

The Fish Passage Center's Annual report for 2001 reported that approximately 15,300 adult summer chinook were counted at Ice Harbor Dam with nearly 14,000 passing Lower Granite Dam in 2001. The summer chinook count at Lower Granite was about 3.5 times greater than the 2000 and 10-year average. Snake River summer chinook are mainly destined for the South Fork of the Salmon River and its tributaries and Pahsimeroi River.

Aggregate returns of spring-run chinook (as measured at Lower Granite Dam) showed a large increase over recent year abundances. The 1997-2001 geometric mean return of natural-origin chinook exceeded 3,700. The increase was largely driven by the 2001 return—estimated to have exceeded 17,000 naturally produced spring chinook—however, a large proportion of the run in 2001 was estimated to be of hatchery origin (98.4%). The summer run over Lower Granite Dam has increased as well. The 1997-2001 geometric mean total return was slightly more than 6,000. The geometric mean return for the broodyears for the recent returns (1987-96) was 3,076 (Note: does not address hatchery/wild breakdowns of the aggregate run).

For the SR spring/summer chinook salmon ESU as a whole, NMFS estimates that the median population growth rate over the base period ranges from 0.96 to 0.80, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to the effectiveness of fish of wild origin (McClure *et al.* 2000b). NMFS has also estimated median population growth rates and the risk of absolute extinction for seven spring/summer chinook salmon index stocks, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years for the wild component ranges from zero for Johnson Creek to 0.78 for the Imnaha River (McClure *et al.* 2000b). At the high end, assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100 percent), the risk of absolute extinction within 100 years ranges from zero for Johnson Creek to 1.00 for the wild component in the Imnaha River (McClure *et al.* 2000b).

Snake River Fall Chinook Salmon

Information on the status and distribution of SR fall chinook salmon is found in the status review prepared by the Northwest Fisheries Science Center, NMFS (Waples *et al.* 1991b). More recent information on the status and distribution of the chinook salmon ESU is provided in the Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California prepared by the West Coast Chinook Salmon Biological Review Team (Myers *et al.* 1998), and in the Preliminary Conclusions Regarding the Updated Status of listed ESUs of West Coast Salmon and Steelhead (NMFS 2003). The discussions in these documents are summarized below. Information on critical habitat for threatened SR fall chinook salmon is found in the *Federal Register* notice that designates critical habitat for this species (NOAA 1993b).

No reliable estimates of historical abundance are available. Because of their dependence on mainstem habitat for spawning, however, fall chinook salmon probably have been affected by the development of irrigation and hydroelectric projects to a greater extent than any other species of salmon. It has been estimated that the mean number of adult SR fall chinook salmon declined from 72,000 in the 1930s and 1940s to 29,000 during the 1950s. Despite this decline, the Snake River remained the most important natural production area for fall chinook salmon in the entire Columbia River Basin through the 1950s. The number of adults counted at the uppermost Snake River mainstem dams averaged 12,720 total spawners from 1964 to 1968, 3,416 spawners from 1969 to 1974, and 610 spawners from 1975 to 1980 (Waples *et al.* 1991b).

Counts of natural-origin adult fish continued to decline through the 1980s, reaching a low of 78 individuals in 1990. Since then, the return of natural-origin fish to Lower Granite Dam has varied, but has generally increased. The 1999 NMFS Status Review Update noted increases in the Lower Granite Dam counts in the mid-1990s, and the upward trend in returns—the 2001 count over Lower Granite Dam exceeded 8,700 adult fall chinook—has continued. The 1997 through 2001 escapements were the highest on record since the count of 1,000 in 1975. Wild chinook returns and hatchery returns from increased production in the Lyons Ferry Hatchery Snake River egg bank stock have provided the bulk of the increase in returns. Returns classified as natural origin exceeded 2,600 in 2001. The 1997-2001 geometric mean natural origin count over Lower Granite Dam was 871 fish. The largest increase in fall chinook returns to the Snake River spawning area was from the Lyons Ferry Snake River stock component. Returns increased from under 200 per year prior to 1998 to over 1,200 and 5,300 adults in 2000 and 2001, respectively. The increase includes returns from the on-station release program as well as returns from large supplementation releases above Lower Granite Dam.

Recent analyses conducted through the PATH (Program for Analyzing and Testing Hypotheses) process considered the prospects for survival and recovery given several future management options for the hydrosystem and other mortality sectors (Marmorek and Peters 1998, Peters *et al.* 1999). That analysis indicated that the prospects of survival for SR fall chinook salmon were good, but that full recovery was relatively unlikely except under a very limited range of assumptions, or unless drawdown was implemented for at least the four lower Snake River dams. Consideration of the drawdown options led to a high likelihood that both survival and recovery objectives could be achieved.

Both the long-term and short-term trends in natural returns are positive (1.013, 1.188). The short-term (1990-2001) estimates of the median population growth rate (λ) are 0.98 with a hatchery spawning effectiveness of 1.0 (equivalent to that of wild spawners) and 1.137 with a hatchery spawning effectiveness of 0. The estimated long-term growth rate for the Snake River fall chinook population is strongly influenced by the hatchery effectiveness assumption. If hatchery spawners have been equally as effective as natural-origin spawners in contributing to brood year returns, the long-term λ estimate is 0.899 and the associated probability that λ is less than 1.0 is estimated as 98.7%. If hatchery returns over Lower Granite Dam are not contributing at all to natural production, the long-term estimate of λ is 1.024. The associated probability that λ is greater than 1.0 is 25.7%, under the assumption that hatchery effectiveness is 0.

SR Steelhead

Information on the status and distribution of SR fall chinook salmon is found in the status review prepared by the NWFSC (Waples *et al.* 1991b). More recent information on the status and distribution of the SR steelhead ESU is provided in the Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California (Busby et al.1996), the Status Review Update for West Coast Steelhead from Washington, Idaho, Oregon, and California (NMFS 1997), and in the Preliminary Conclusions Regarding the Updated Status of listed ESUs of West Coast Salmon and Steelhead (NMFS 2003). The discussions in these documents are summarized below.

The longest consistent indicator of steelhead abundance in the Snake River Basin is derived from counts of natural-origin steelhead at the uppermost dam on the lower Snake River. According to these estimates, the abundance of natural-origin summer steelhead at the uppermost dam on the Snake River has declined from a 4-year average of 58,300 in 1964 to a 4-year average of 8,300 ending in 1998. In general, steelhead abundance declined sharply in the early 1970s, rebuilt modestly from the mid-1970s through the 1980s, and declined again during the 1990s. The 2001 count at Ice Harbor Dam was 255,726 with Lower Granite reporting 262,558. Numbers of "wild" steelhead increased to about 47,700 at Lower Granite in 2001. (FPC, 2002)

With a few exceptions, annual estimates of steelhead returns to specific production areas within the Snake River are not available. Annual return estimates are limited to counts of the aggregate return over Lower Granite Dam. Returns to Lower Granite remained at relatively low levels through the 1990s. The 2001 run size at Lower Granite Dam was substantially higher than those in the 1990s. Annual estimates of returns are available for the Tucannon River, sections of the Grande Ronde River system and the Imnaha River. The recent geometric mean abundance was down for the Tucannon relative to the last BRT status review. Returns to the other areas were generally higher relative to the early 1990s (NMFS 2003).

Overall, long-term trends remained negative for four of the nine available series (including both aggregate measures and specific production area estimates). Short-term trends improved relative to the period analyzed for the previous status review. The median short-term trend was +2.0% for the 1990-2001 period. Five out of the nine data sets showed a positive trend. IDFG has provided updated analyses of parr density survey results through 1999. They concluded that “generational parr density trends, which are analogous to spawner to spawner survivorship, indicate that Idaho spring-summer chinook and steelhead with and without hatchery influence failed to meet replacement for most generations competed since 1985" (IDFG 2002). These data do not reflect the influence of increased returns in 2001 and 2002.

Population growth rate (λ) estimates showed a corresponding pattern. The median longterm λ estimate across the nine series was .998 assuming that natural returns are produced only from natural origin spawners and .733 if both hatchery and wild potential spawners are assumed to have contributed to production. Short-term λ estimates are higher, 1.013, assuming a hatchery effectiveness of 0, and .753, assuming hatchery and wild fish contribute to natural production in proportion to their numbers.

Summary

Thus, the degree to which SR sockeye, chinook, and steelhead chinook biological requirements are being met in the action area with respect to population numbers and distribution is something of a mixed bag. While some improvement can be seen in recent years, all four ESUs are still at critically low levels compared to both historic production and the desired escapement levels—particularly for natural fish. Therefore, while there is some cause for very guarded optimism, there has been no genuine change in the species' status since they were listed under the ESA, and the most likely scenario is that their biological requirements are not currently being met with respect to abundance, distribution, or overall trend.

Factors Affecting the Environmental Baseline in the Action Area

Environmental baselines for biological opinions are defined by regulation at 50 CFR 402.02, which states that an environmental baseline is the physical result of all past and present state, Federal, and private activities in the action area along with the anticipated impacts of all proposed Federal projects in the action area (that have already undergone formal or early section 7 consultation). The environmental baseline for *this* biological opinion is therefore the result of the impacts a great many activities (summarized below) have had on SR sockeye, chinook, and steelhead survival and recovery. Put another way (and as touched upon previously), the baseline is the culmination of the effects that multiple activities have had on the species' *biological requirements* and, by examining those individual effects, it is possible to derive the species' status in the action area.

Many of the biological requirements for listed SR salmonids in the action area can best be expressed in terms of essential habitat features. That is, the fish require adequate: (1) substrate (especially spawning gravel), (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) migration conditions (65 FR 7764). The best scientific information presently available demonstrates that a multitude of factors, past and present, have contributed to the decline of west coast salmonids by adversely affecting these essential habitat features. These factors are well known and documented in dozens—if not hundreds—of scientific papers, policy documents, news articles, books, and other media. It is therefore unnecessary to detail in this opinion the many ways in which human activities and natural factors have affected the SR salmon and steelhead's habitat-related biological requirements; thus the following paragraphs constitute a brief summary of what the most recent accepted science has to say about how human action and natural processes have degraded essential steelhead habitat features in the Snake River basin.

Some factors in the action area (e.g., hydropower and agricultural development—particularly irrigation diversions) have had adverse effects on every single one of the habitat-related biological requirements listed above, while other factors have only affected some of those essential habitat features. For example, road building in the Snake River basin has had a sizeable effect on stream substrates and water quality (through siltation), and road culverts have blocked fish passage, but such activities have not had much of an effect on water velocity. In another instance, timber harvest and grazing activities have affected—to greater or lesser degrees—all the factors except space. And urban development has affected them all, but generally to a very small degree in the largely rural Snake River. In short, nearly every widespread human activity in the basin has adversely affected some or all of habitat features listed above. And by disrupting those habitat features, these activities—coupled with hatchery and fishery effects and occasional natural disturbances such as drought and fire—have had detrimental impacts on SR salmon steelhead health, physiology, numbers, and distribution in every subpopulation and at every life stage. (The impacts generated by hatchery operations and fish harvest have decreased greatly in recent years—particularly hatchery impacts as hatcheries are now being re-designed to supplement natural populations rather than replaces them.) For detailed information on how various factors have degraded essential habitat features in the Snake River basin, please see any of the following: NMFS (1991), NRC (1996) NMFS (1997), NMFS (1999), NMFS (2002a), NMFS (2003) and, in particular, NMFS (2000b).

<u>Summary</u>

In conclusion, the picture of whether SR salmonid biological requirements are being met is more clear-cut for habitat-related parameters than it is for population factors: given all the factors for decline, it is clear that the SR salmon and steelhead's biological requirements are currently not being met under the environmental baseline. Thus their status is such that there must be a significant improvement in the environmental conditions of their habitat (over those currently available under the environmental baseline). Any further degradation of the environmental conditions could have a large impact because the species are already at risk. In addition, there must be efforts to minimize impacts caused by dams, harvest, hatchery operations, habitat degradation, and unfavorable natural conditions.

EFFECTS OF THE PROPOSED ACTIONS

Evaluating the Effects of the Action

Over the course of the last decade and hundreds of ESA section 7 consultations, NMFS developed the following four-step approach for applying the ESA Section 7(a)(2) standards when determining what effect a proposed action is likely to have on a given listed species. What follows here is a summary of that approach.

1. Define the biological requirements and current status of each listed species.

2. Evaluate the relevance of the environmental baseline to the species' current status.

3. Determine the effects of the proposed or continuing action on listed species and their habitat.

4. Determine whether the species can be expected to survive with an adequate potential for recovery under (a) the effects of the proposed (or continuing) action, (b) the effects of the environmental baseline, and (c) any cumulative effects—including all measures being taken to improve salmonid survival and recovery.

The fourth step above requires a two-part analysis. The first part focuses on the action area and defines the proposed action's effects in terms of the species' biological requirements in that area (i.e., impacts on essential habitat features). The second part focuses on the species itself. It describes the action's impact on individual fish—or populations, or both—and places that impact in the context of the ESU as a whole. Ultimately, the analysis seeks to answer the questions of whether the proposed action is likely to jeopardize a listed species' continued existence or destroy or adversely modify its critical habitat (if any exists).

Effects on Designated Critical Habitat

Previous sections have discussed the scope of the SR salmon and steelhead habitat in the action area, described the essential features of that habitat, and depicted its present condition. The discussion here focuses on how those features are likely to be affected by the proposed actions.

Full descriptions of the proposed activities are found in the next section. In general, the activities will be (a) electrofishing—using both backpack- and boat-based equipment, (b) snorkel surveys in spawning and rearing habitat, (c) capturing fish with angling equipment, traps, and nets of various types, and (d) marking the captured fish with various types of tags. All of these techniques are minimally intrusive in terms of their effect on habitat. None of them will measurably affect any of the 10 essential fish habitat features listed earlier (i.e., stream substrates, water quality, water quantity, food, streamside vegetation, etc.). Moreover, the proposed activities are all of short duration. Therefore, NMFS concludes that the proposed activities are not likely to adversely modify or destroy critical habitat for any of the listed salmonids in the Snake River; nor would any of the activities jeopardize the fish by reducing the ability of that critical habitat to contribute to their survival and recovery.

Effects on SR Sockeye, Spr/sum Chinook, Fall Chinook, and Steelhead

The primary effects the proposed activities will have on listed SR fish will occur in the form of direct “take” (the ESA take definition is given in the section introducing the individual permits), a major portion of which comes in the form of harassment. Harassment generally leads to stress and other sub-lethal effects and is caused by observing, capturing, and handling fish. The ESA does not define harassment nor has NMFS defined this term through regulation. However, the USFWS defines harassment as “an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to breeding, feeding or sheltering” [50 CFR 17.3]. For the purposes of this analysis, NMFS adopts this definition of harassment.

The various proposed activities would cause many types of take, and while there is some blurring of the lines between what constitutes an activity (e.g., electrofishing) and what constitutes a take category (e.g., harm), it is important to keep the two concepts separate. The reason for is this is that the effects being measured here are those which the activity itself has on the listed species. They may be expressed in *terms* of the take categories (e.g., how many SR sockeye, chinook, and steelhead are harmed, or harassed, or even killed), but the actual mechanisms of the effects themselves (i.e., the activities) are the causes of whatever take arises and, as such, they bear examination. Therefore, the first part of this section is devoted to a discussion of the general effects known to be caused by the proposed activities—regardless of where they occur or what species are involved.

The following subsections describe the types of activities being proposed. Because they would all be carried out by trained professionals using established protocols and have widely recognized specific impacts, each activity is described in terms broad enough to apply to every proposed permit. This is especially true in light of the fact that the researchers would not receive a permit unless their activities (e.g., electrofishing) incorporate NMFS’ uniform, pre-established set of mitigation measures.

Observation

For some studies, listed fish will be observed in-water (i.e., snorkel surveys). Direct observation is the least disruptive method for determining presence/absence of the species and estimating their relative abundance. Its effects are also generally the shortest-lived among any of the research activities discussed in this section. Typically, a cautious observer can effectively obtain data without disrupting the normal behavior of a fish. Fry and juveniles frightened by the turbulence and sound created by observers are likely to seek temporary refuge in deeper water or behind or under rocks or vegetation. In extreme cases, some individuals may temporarily leave a particular pool or habitat type when observers are in their area. Researchers minimize the amount of disturbance by moving through streams slowly—thus allowing ample time for fish to reach escape cover; though it should be noted that the research may at times involve observing adult fish—which are more sensitive to disturbance. During some of the research activities discussed below, redds may be visually inspected, but no redds will be walked on. Harassment is the primary form of take associated with these observation activities, and few if any injuries or deaths are expected to occur—particularly in cases where the observation is to be conducted solely by researchers on the stream banks rather than in the water. There is little a researcher can do to mitigate the effects associated with observation activities because those effects are so minimal. In general, all they can do is move with care and attempt to avoid disturbing sediments, gravels, and, to the extent possible, the fish themselves.

Capture/handling

Capturing and handling fish causes them stress—though they typically recover fairly rapidly from the process and therefore the overall effects of the procedure are generally short-lived. The primary contributing factors to stress and death from handling are excessive doses of anesthetic, differences in water temperatures (between the river and wherever the fish are held), dissolved oxygen conditions, the amount of time that fish are held out of the water, and physical trauma. Stress on salmonids increases rapidly from handling if the water temperature exceeds 18°C or dissolved oxygen is below saturation. Fish that are transferred to holding tanks can experience trauma if care is not taken in the transfer process, and fish can experience stress and injury from overcrowding in traps if the traps are not emptied on a regular basis. Debris buildup at traps can also kill or injure fish if the traps are not monitored and cleared on a regular basis.

Based on prior experience with the research techniques and protocols that would be used to conduct the proposed scientific research, no more than five percent of the juvenile salmonids encountered are likely to be killed as an indirect result of being captured and handled and, in most cases, that figure will not exceed three percent. In addition, it is not expected that more than one percent of the adults being handled will die. In any case, all researchers will adhere to the terms and conditions described earlier (page 4) and thereby keep adverse effects to a minimum. Finally, any fish unintentionally killed by the research activities in the proposed permits may be retained as reference specimens or used for analytical purposes.

Electrofishing

Electrofishing is a process by which an electrical current is passed through water containing fish in order to stun them—thus making them easier to capture. It can cause a suite of effects ranging from simple harassment to actually killing the fish (adults and juveniles) in an area where it is occurring. The amount of unintentional mortality attributable to electrofishing may vary widely depending on the equipment used, the settings on the equipment, and the expertise of the technician. Electrofishing can have severe effects on adult salmonids. Spinal injuries in adult salmonids from forced muscle contraction have been documented. Sharber and Carothers (1988) reported that electrofishing killed 50 percent of the adult rainbow trout in their study. The long-term effects electrofishing has on both juvenile and adult salmonids are not well understood, but long experience with electrofishing indicates that most impacts occur at the time of sampling and are of relatively short duration.

The effects electrofishing may have on listed SR fish would be limited to the direct and indirect effects of exposure to an electric field, capture by netting, holding captured fish in aerated tanks, and the effects of handling associated with transferring the fish back to the river (see the next subsection for more detail on capturing and handling effects). Most of the studies on the effects of electrofishing on fish have been conducted on adult fish greater than 300 mm in length (Dalbey et al. 1996). The relatively few studies that have been conducted on juvenile salmonids indicate that spinal injury rates are substantially lower than they are for large fish. Smaller fish intercept a smaller head-to-tail potential than larger fish (Sharber and Carothers 1988) and may therefore be subject to lower injury rates (e.g., Hollender and Carline 1994, Dalbey et al. 1996, Thompson et al. 1997). McMichael et al. (1998) found a 5.1% injury rate for juvenile MCR steelhead captured by electrofishing in the Yakima River subbasin. The incidence and severity of electrofishing damage is partly related to the type of equipment used and the waveform produced (Sharber and Carothers 1988, McMichael 1993, Dalbey et al. 1996, Dwyer and White 1997). Continuous direct current (DC) or low-frequency (≤30 Hz) pulsed DC have been recommended for electrofishing (Fredenberg 1992, Snyder 1992 and 1995, Dalbey et al. 1996) because lower spinal injury rates, particularly in salmonids, occur with these waveforms (Fredenberg 1992, McMichael 1993, Sharber et al. 1994, Dalbey et al. 1996). Only a few recent studies have examined the long-term effects of electrofishing on salmonid survival and growth (Ainslie et al. 1998, Dalbey et al. 1996). These studies indicate that although some of the fish suffer spinal injury, few die as a result. However, severely injured fish grow at slower rates and sometimes they show no growth at all (Dalbey et al. 1996).

NMFS' electrofishing guidelines (NMFS 2000a) will be followed in all surveys employing electrofishing equipment. The guidelines require that field crews be trained in observing animals for signs of stress and shown how to adjust electrofishing equipment to minimize that stress. Electrofishing is used only when other survey methods are not feasible. All areas for stream and special needs surveys are visually searched for fish before electrofishing may begin. Electrofishing is not done in the vicinity of redds or spawning adults. All electrofishing equipment operators are trained by qualified personnel to be familiar with equipment handling, settings, maintenance, and safety. Operators work in pairs to increase both the number of fish that may be seen and the ability to identify individual fish without having to net them. Working in pairs also allows the researcher to net fish before they are subjected to higher electrical fields. Only DC units will be used, and the equipment will be regularly maintained to ensure proper operating condition. Voltage, pulse width, and rate will be kept at minimal levels and water conductivity will be tested at the start of every electrofishing session so those minimal levels can be determined. When such low settings are used, shocked fish normally revive instantaneously. Fish requiring revivification will receive immediate, adequate care.

The preceding discussion focused on the effects of using a backpack unit for electrofishing and the ways those effects will be mitigated. It should be noted, however, that in larger streams and rivers electrofishing units are sometimes mounted on boats or rafts. These units often use more current than backpack electrofishing equipment because they need to cover larger (and deeper) areas and, as a result, can have a greater impact on fish. In addition, the environmental conditions in larger, more turbid streams can limit researchers' ability to minimize impacts on fish. That is, in areas of lower visibility it can be difficult for researchers to detect the presence of adults and thereby take steps to avoid them. Because of its greater potential to harm fish, and because NMFS has not published appropriate guidelines, boat electrofishing has not been given a general authorization under NMFS' recent ESA section 4(d) rules. However, it is expected that guidelines for safe boat electrofishing will be in place in the near future. And in any case, all researchers intending to use boat electrofishing will use all means at their disposal to ensure that a minimum number of fish are harmed (these means will include a number of long-established protocols that will eventually be incorporated into NMFS' guidelines).

Tagging/marking

Techniques such as PIT-tagging (passive integrated transponder tagging), coded wire tagging, fin-clipping, and the use of radio transmitters are common to many scientific research efforts using listed species. All sampling, handling, and tagging procedures have an inherent potential to stress, injure, or even kill the marked fish. This section discusses each of the marking processes and its associated risks.

A PIT tag is an electronic device that relays signals to a radio receiver; it allows salmonids to be identified whenever they pass a location containing such a receiver (e.g., any of several dams) without researchers having to handle the fish again. The tag is inserted into the body cavity of the fish just in front of the pelvic girdle. The tagging procedure requires that the fish be captured and extensively handled, therefore any researchers engaged in such activities will follow the conditions listed in the Description of the Proposed Actions section (as well as any permit-specific terms and conditions) to ensure that the operations take place in the safest possible manner. In general, the tagging operations will take place where there is cold water of high quality, a carefully controlled environment for administering anesthesia, sanitary conditions, quality control checking, and a carefully regulated holding environment where the fish can be allowed to recover from the operation.

PIT tags have very little effect on growth, mortality, or behavior. The few reported studies of PIT tags have shown no effect on growth or survival (Prentice et al. 1987; Jenkins and Smith 1990; Prentice et al. 1990). For example, in a study between the tailraces of Lower Granite and McNary Dams (225 km), Hockersmith et al. (2000) concluded that the performance of yearling chinook salmon was not adversely affected by gastrically- or surgically implanted sham radio tags or PIT-tags. Additional studies have shown that growth rates among PIT-tagged Snake River juvenile fall chinook salmon in 1992 (Rondorf and Miller 1994) were similar to growth rates for salmon that were not tagged (Conner et al. 2001). Prentice and Park (1984) also found that PIT-tagging did not substantially affect survival in juvenile salmonids.

Another primary method for tagging fish is to implant them with radio tags. There are two main ways to accomplish this and they differ in both their characteristics and consequences. First, a tag can be inserted into a fish's stomach by pushing it past the esophagus with a plunger. Stomach insertion does not cause a wound and does not interfere with swimming. This technique is benign when salmon are in the portion of their spawning migrations during which they do not feed (Nielsen, 1992). In addition, for short-term studies, stomach tags allow faster post-tagging recovery and interfere less with normal behavior than do tags attached in other ways.

The second method for implanting radio tags is to place them within the body cavities of (usually juvenile) salmonids. These tags do not interfere with feeding or movement. However, the tagging procedure is difficult, requiring considerable experience and care (Nielson 1992). Because the tag is placed within the body cavity, it is possible to injure a fish's internal organs. Infections of the sutured incision and the body cavity itself are also possible, especially if the tag and incision are not treated with antibiotics (Chisholm and Hubert 1985, Mellas and Haynes 1985).

Fish with internal radio tags often die at higher rates than fish tagged by other means because radio tagging is a complicated and stressful process. Mortality is both acute (occurring during or soon after tagging) and delayed (occurring long after the fish have been released into the environment). Acute mortality is caused by trauma induced during capture, tagging, and release. It can be reduced by handling fish as gently as possible. Delayed mortality occurs if the tag or the tagging procedure harms the animal in direct or subtle ways. Tags may cause wounds that do not heal properly, may make swimming more difficult, or may make tagged animals more vulnerable to predation (Howe and Hoyt 1982, Matthews and Reavis 1990, Moring 1990). Tagging may also reduce fish growth by increasing the energetic costs of swimming and maintaining balance. As with the other forms of tagging and marking, researchers will keep the harm caused by radio tagging to a minimum by following the conditions given on page 6 of this Opinion, as well as any other permit-specific requirements.

Fin clipping is the process of removing part or all of one or more fins to alter a fish's appearance and thus make it identifiable. When entire fins are removed, it is expected that they will never grow back. Alternatively, a permanent mark can be made when only a part of the fin is removed or the end of a fin or a few fin rays are clipped. Although researchers have used all fins for marking at one time or another, the current preference is to clip the adipose, pelvic, or pectoral fins. Marks can also be made by punching holes or cutting notches in fins, severing individual fin rays (Welch and Mills 1981), or removing single prominent fin rays (Kohlhorst 1979). Many studies have examined the effects of fin clips on fish growth, survival, and behavior. The results of these studies are somewhat variable; however, it can be said that fin clips do not generally alter fish growth. Studies comparing the growth of clipped and unclipped fish generally have shown no differences between them (e.g., Brynildson and Brynildson 1967). Moreover, wounds caused by fin clipping usually heal quickly—especially those caused by partial clips.

Mortality among fin-clipped fish is also variable. Some immediate mortality may occur during the marking process, especially if fish have been handled extensively for other purposes (e.g., stomach sampling). Delayed mortality depends, at least in part, on fish size; small fishes have often been found to be susceptible to it and Coble (1967) suggested that fish shorter than 90 mm are at particular risk. The degree of mortality among individual fishes also depends on which fin is clipped. Studies show that adipose- and pelvic-fin-clipped coho salmon fingerlings have a 100% recovery rate (Stolte 1973). Recovery rates are generally recognized as being higher for adipose- and pelvic-fin-clipped fish in comparison to those that are clipped on the pectoral, dorsal, and anal fins (Nicola and Cordone, 1973).Clipping the adipose and pelvic fins probably kills fewer fish because these fins are not as important as other fins for movement or balance (McNeil and Crossman 1979). Mortality is generally higher when the major median and pectoral fins are clipped. Mears and Hatch (1976) showed that clipping more than one fin may increase delayed mortality, but other studies have been less conclusive.

Regardless, any time researchers clip or remove fins, it is necessary that the fish be handled. Therefore, the same safe and sanitary conditions required for tagging operations also apply to clipping activities.

<u>Sacrifice</u>

In some instances, it is necessary to kill a captured fish in order to gather whatever data a study is designed to produce. In such cases, determining effect is a very straightforward process: the sacrificed fish, if juveniles, are forever removed from the ESU's gene pool; if the fish are adults, the effect depends upon whether they are killed before or after they have a chance to spawn. If they are killed after they spawn, there is very little overall effect. Essentially, it amounts to removing the nutrients their bodies would have provided to the spawning grounds. If they are killed before they spawn, not only are they removed from the ESU, but so are all their potential progeny. Thus, killing pre-spawning adults has the greatest potential to affect their ESU and, because of this, NMFS rarely allows it to happen. And, in almost every instance where it is allowed, the adults are stripped of sperm and eggs so their progeny can be raised in a controlled environment such as a hatchery—thereby greatly decreasing the potential harm posed by sacrificing the adults. Clearly, there is no way to mitigate the effects of outrightly sacrificing a fish.

Permit-Specific Effects

Permit 1124

Permit 1124 would allow the IDFG to annually take adult and juvenile threatened SR fall chinook salmon; adult and juvenile threatened spring/summer SR chinook salmon (natural and artificially propagated); and adult and juvenile endangered SR sockeye salmon in the Salmon and Clearwater River subbasins in Idaho. The requested take would be distributed among eight projects (see proposed action).

Most of the requested take is for juvenile fish. Juveniles would be captured with trawls, beach seines, screw traps, scoop (inclined screen) traps, baited minnow traps, hook and line, and by electrofishing, depending on species, the purpose of the research, and logistics. Most juvenile fish would be caught in screw traps. The traps would be checked often to prevent overcrowding and to ensure that they are operating properly. Typically, staff would visit a trap several times a day. The traps are pulled or shut down in situations where risks to the welfare of the fish (or personnel) are unacceptable. Trawling would be conducted to provide population estimates of kokanee salmon inhabiting lakes where sockeye preservation/reintroduction efforts are occurring. Mid-water trawling activities include the use of hydroacoustic equipment to locate kokanee. Beach seining may be used to collect juvenile chinook salmon. When fish are collected by angling, the researchers would use small dry flies with single, barbless hooks. Electrofishing would be used only when the previously described methods are not effective. All electrofishing would be conducted in accordance with NMFS' guidelines (NMFS 2000a).

Some of the research, particularly supplementation programs, would require trapping, handling, tagging, and subsequently tracking or observing adult fish. Any of the following biological data may be collected: length, weight, gender, marks, scale samples, tissue samples. The fish would always be handled with great care and they would be kept in water as much as possible during sampling procedures. Adults may be held for as long as 12 hours after collection and handling to ensure their full recovery before releasing them, although in most cases fish will be released immediately after samples are obtained provided they show no signs of injury or distress during the procedure. Weirs and traps would be checked at least twice daily to minimize the time fish are detained.

A variety of internal and external tags and marks may be used including PIT tags, visual implant tags, fin clips, disc tags, radio tags, Floy tags, and jaw tags. Tags used would depend fish size, morphology, and species, and all tags would be applied according to accepted protocols. Most tagging operations would involve the use of an anesthetic, typically MS-222, although other methods (e.g. CO_2 or clove oil) may be considered depending on their efficacy and the fishes' needs. Environmental conditions, such as water temperature, will be considered in all collection and tagging activities to ensure safety of the fish. All tagging supplies would be disinfected before each use. The type of tag used will be determined by the intended purpose of the research; some tags will be permanent and some will be temporary.

Holding time would vary according to specific research needs, water temperatures, oxygen content, and condition of the fish. Typically when fish are being counted and sampled, (e.g. length, weight, scales, tissue), they would be released immediately. Fish will be held long enough to ensure they have fully recovered from sampling/tagging procedures, and to maximize their chances for survival after release. For example, juveniles may be held in perforated containers "in-stream" for several hours so they can be released after dark to minimize the risk of predation. Fish may be held overnight and released early the next morning when water temperatures are more favorable. Occasionally fish are held for up to 24 hours to provide an estimate of tagging mortality. All animals would be held under safe, healthy conditions in a variety of containers. Fish are held in clean, well-aerated water of the appropriate temperature. Water temperatures in holding containers and streams are usually similar enough that tempering is unnecessary. However, when temperature differences are a concern, releases are made gradually to avoid temperature shock. Research activities may be curtailed when holding conditions jeopardize the welfare of the fish. For example, PIT tagging would not occur when water temperatures exceed about 16^{o}C.

The number and types of samples taken would be tailored to meet the objectives of each particular research project. Biological sampling would be conducted according to standard protocols. For each individual, the following is typically recorded, length, weight, location captured, and date. Scales (juvenile and adults) and otoliths (adult carcasses) may be taken for aging purposes. Tissue samples may be taken for genetic and fish health/pathology purposes. Some fish health and genetics projects may require lethal sampling. In cases where lethal sampling occurs, the IDFG will make every attempt to maximize information obtained from sacrificed fish by coordinating with other agencies and tribes.

The amounts and types of take being requested for the eight IDFG projects are displayed in the following table. It is important to note that in this and all other instances where unintentional mortalities are displayed, the number of dead fish is a part of the overall take request. Thus, for example, in the first line of the table below, IDFG is asking to take 75 adult SR sockeye salmon; the fish that may die as a result of that action come *out of* that total. They are not added to it.

Table 1. Requested Take by ESU, Life Stage, and Activity for Permit 1124.

ESU/Species	Life Stage	Take Activity	Requested Take	Unintentional Mortality
Sockeye	Adult	C/H/TS/R	75	2
Sockeye	Adult	CT	50	1
Sockeye	Juvenile	LT	100	N/A
Sockeye	Juvenile	C/H/R	50	2
Sockeye	Juvenile	CT	3,000	60
Spr/sum Chinook	Adult	C/H/TS/R	2,500	5
Spr/sum Chinook	Adult	CT	100	1
Spr/sum Chinook	Juvenile	C/H/T/TS/R	295,000	1,400
Spr/sum Chinook	Juvenile	LT	750	N/A
Spr/sum Chinook	Juvenile	CT	10,000	200
Fall Chinook	Adult	C/H/TS/R	1,500	3
Fall Chinook	Adult	CT	100	1
Fall Chinook	Juvenile	C/H/TS/R	1,000	30
Fall Chinook	Juvenile	CT	5,000	100

(C=Capture, H=Handle, T=Tag, TS=Tissue sample, LT=Lethal Take, CT=collect for transport, R=Release)

To put this take request into context, it is necessary to look at the numbers of juvenile fish expected to outmigrate in the 2003 season, and the numbers of adult fish that have been returning over Lower Granite Dam and moving into the Snake River basin. The following table displays these figures. The adult numbers were taken from NMFS (2003) and the juvenile numbers were taken from the outmigration estimate NMFS publishes every year (Ferguson 2003).

Table 2. Expected Outmigration Numbers and Recent Five-year Geometric Means* for Returning Salmonids in the Snake River Basin.

ESU	Life Stage	Returns/Outmigrants
Sockeye	Adult	62
Sockeye	Juvenile	55,304
Spr/Sum Chinook	Adult	50,000
Spr/Sum Chinook	Juvenile	4,207,310
Fall Chinook	Adult	871
Fall Chinook	Juvenile	1,051,615
Steelhead	Adult	14,768
Steelhead	Juvenile	1,456,575

*Except adult sockeye and spr/sum chinook. For sockeye the figure is a straight, 5-year average from 1998-2002 (NMFS 2003), and for spr/sum chinook it is a low estimate of the 5-year average from 1997-2001 (NMFS 2003).

By combining Tables 1 and 2, it is possible to determine what percentages of the outmigration/returns would be taken, and what percentage would be killed under Permit 1124:

Table 3. Percentage of the 2003 Outmigration and Recent Average Returns* Likely to be Affected by Permit 1124.

ESU/Species	% Returns Taken	% Mortalities	% of Outmigration Taken	% Mortalities
SR Sockeye	200%	5%	5.5%	2.9%
SR Spr/sum Chinook	5.2%	0.1%	7.0%	0.05%
SR Fall Chinook	172%	0.5%	0.6%	0.01%

*Except Sockeye. Sockeye are a special case and the requested take for this species is discussed in more detail below

Clearly, the anomalous numbers here are the 172% of the fall chinook and the 200% of the sockeye returns requested to be taken. In the case of the SR fall chinook, the reason for the high take level is that the requested take is based upon recent return trends instead of the five-year geometric mean. Last year, nearly 9,000 fall chinook crossed Lower Granite Dam (NMFS 2003), a tenfold increase over the 871 fish that represent the 1997-2001 mean. Thus the likelihood is that something much closer to 17% of the run (instead of 172%) will be taken in any way. Note that this means the actual mortality numbers would probably undergo a similar tenfold reduction and represent a loss of 0.05% instead of 0.5%.

A similar situation exists for SR sockeye. At a glance, it would appear that the IDFG is requesting to take twice as many sockeye as are expected to return and would kill nearly 5% of a critically endangered outmigration. In reality, higher return numbers (than the recent average) are expected and the fish are being taken for two very good reasons. First, many of them are being transported to ensure they reach the spawning grounds of Redfish Lake—and if one dies along the way (unlikely in any case), it is less than the number that would die if they continued their migration naturally. Second, the majority of the fish would be taken for incorporation into a captive broodstock program designed for one purpose—to keep the sockeye from going extinct. The entire purpose of the research is to preserve the fish and it is eminently arguable that without the program, the SR sockeye would have become extinct years ago. Thus the requested sockeye take is not a detriment, but rather, is critically important to their survival.

As to the spr/sum chinook, the large numbers being taken and tagged are critical to many different programs designed to help recover them—not the least of which is the yearly NMFS outmigration estimate through which managers can determine how best to adjust their various programs on a year-to-year basis. And in any case, the number of fish expected to be killed (at worst) represents a negligible fraction of the outmigration and the effects of the loss are entirely discountable in the face of the beneficial information to be produced.

<u>Permit 1134</u>

Permit 1134 would allow CRITFC to annually take adult and juvenile threatened SR fall chinook salmon; adult and juvenile threatened SR spring/summer chinook salmon (natural and artificially propagated); and adult and juvenile threatened SR steelhead at many locations in the Snake River basin. The request is for five projects (see Proposed Action), but in reality the take would be distributed among only three of the projects because Project 1 involves only aerial and ground surveys and Project 3 involves observing fish (using video weirs, PIT-tag detectors, and acoustic imaging) and neither would have a measurable impact on the fish to be observed. Some harassment may occur, but it would be very short-lived and would involve no physical contact. Under Project 1, the researchers may also examine and take tissue samples from an indeterminate number of carcasses found during the surveys—another practice that would not measurably harm listed species and arguably would benefit them (if, for example, pathogens were to be found, managers would be able to make an early and effective response to the threat). Therefore the discussion of the effects likely to be associated with permit will be divided into sections pertaining to each of the other three projects that do have a potential to harm listed fish.

Project 2—Cryopreservation of Spr/sum Chinook Salmon and Summer Steelhead Gametes

Under this project, CRITFC would annually collect spr/sum chinook and steelhead gametes throughout the Snake River basin. The fish would be collected by various methods—dipnet, hand, seine, angling, and at already-established screw traps and hatchery weirs. Once captured, the fish would be tissue sampled (a fin punch and/or a scale taken), examined, and measured. At that point, no females would be handled further and all would be allowed to escape immediately back to the stream. The males would be anesthetized (anywhere from 30 seconds to two minutes), their abdomens wiped dry, and sperm samples would be taken. They would then be placed in a pool area of the stream and assisted until they recover. The sperm samples would be preserved in liquid nitrogen tanks and transported to the University of Idaho and Washington State University.

The amount of take CRITFC is requesting for Project 2 is found in the following table.

Table 4. Requested Take by ESU, Life Stage, and Activity for Study 2 of Permit 1134.

ESU/Species	Life Stage	Take Activity	Requested Take	Unintentional Mortality
SR Spr/sum Chinook	Adult	C/H/TS/R	2970	16
SR Steelhead	Adult	C/H/TS/R	1490	9

(C=Capture, H=Handle, T=Tag, TS=tissue sample, R=Release.)

It should be noted that the actual take numbers from year to year are likely to be lower for two reasons. First, many of the fish being taken under the project—those from extant weirs and screw traps, will actually come under the permits for those operations (and there are approximately 17 of those—capturing as many as 1410 chinook and 1270 steelhead). Second, in the five years this project has previously been permitted, it has resulted in *no* dead salmon or steelhead. Nonetheless, if all the potential deaths were to occur, it would mean approximately 0.03% of the 1997-2001 five-year average returns of spr/sum chinook (a low estimate of 50,000) would be killed (NMFS 2003), as would 0.06% of the 1997-2001 five-year geometric mean returns of SR steelhead (NMFS 2003). These losses are negligible—especially in view of the fact that the research is designed to preserve listed SR chinook and steelhead diversity and, eventually, help recover them.

Project 4—Snorkel, Seine, Minnow Traps, and Electrofishing Surveys and Collection of Juvenile Chinook Salmon and Steelhead

Under Project 4, CRITFC would annually collect and PIT-tag juvenile SR chinook and steelhead. The researchers would use the capture methods listed above. The captured fish would be anesthetized, measured and weighed, scale and/or other tissue samples would be taken in most instances, and many of the fish would be PIT-tagged. Once these operations are complete, the fish would be allowed to recover and move back into the stream. The amounts of take CRITFC is requesting are displayed in the following table. (They also intend to observe a number of fish, but as stated previously, take due to observation/harassment is completely discountable.)

Table 5. Requested Take by ESU, Life Stage, and Activity for Project 4 of Permit 1134.

ESU/Species	Life Stage	Take Activity	Requested Take	Unintentional Mortality
SR Spr/sum Chinook	Juvenile	C/H/R	6,800	32
SR Spr/sum Chinook	Juvenile	C/TS/T/R	6,500	65
SR Fall Chinook	Juvenile	C/H/R	2,000	20
SR Fall Chinook	Juvenile	C/TS/T/R	8,000	80
SR Steelhead	Juvenile	C/H/R	19,550	656

(C=Capture, H=Handle, T=Tag, TS=tissue sample, R=Release.)

This means that CRITFC researchers would kill 0.002%, 0.009%, and 0.05% of the SR spr/sum chinook, fall chinook., and steelhead outmigrations, respectively. These losses are negligible—especially in light of the facts that the research supports a number of basinwide fish- and habitat restoration programs and will help managers monitor trends in listed salmonid population structures over time.

Project 5—Juvenile Anadromous Salmonid Emigration Studies Using Rotary Screw Traps.

Under Project 5, CRITFC researchers will annually trap, anesthetize, examine, measure, and PIT-tag SR spr/sum chinook and steelhead at several rotary screw traps in the upper Snake River Basin. Some of the captured fish would be marked and returned upstream to check trap efficiency. Some adults may be captured during the opeartions, but they will immediately be released.

The amounts of take being requested under Project 5 are displayed in the following table.

Table 5. Requested Take by ESU, Life Stage, and Activity for Project 4 of Permit 1134.

ESU/Species	Life Stage	Take Activity	Requested Take	Unintentional Mortality
SR Spr/sum Chinook	Juvenile	C/H/R	1,667,633	8,338
SR Spr/sum Chinook	Juvenile	C/T/R	58,600	586
SR Spr/sum Chinook	Adult	C/H/R	50	0
SR Steelhead	Juvenile	C/H/R	145,000	2,176
SR Steelhead	Juvenile	C/T/R	25,300	253
SR Steelhead	Adult	C/H/R	105	0

(C=Capture, H=Handle, T=Tag, R=Release.)

This means that the CRITFC researchers would annually kill 0.2% and 0.2% of the outmigrating spr/sum chinook and steelhead, respectively (and none of the adults). Any negative effect to be generated by these operations is offset by the fact that the screw trap and PIT-tagging operations provide managers from several states and agencies with critical information about the yearly outmigration. River and dam operations, land use planning, restoration efforts, and other scientific research projects depend upon the information generated by the CRITFC researchers—and they have done so for many years.

Permit 1140

Permit 1140 would allow the NWFSC to annually capture with a beach seine salmonids in coastal estuaries and the Columbia River. If the beach seine is ineffective, the researchers would use high speed rope/surface trawls or, possibly, a purse seine. The captured fish would be killed, and several tissue samples would be taken from them. In all, the researchers would capture and kill three (3) SR juvenile fall chinook salmon. This means that the researchers would kill 0.0003% of the expected fall chinook outmigration. This level of take is completely negligible. It is even more so in view of the facts that (a) no SR fall chinook may be killed at all, and (b) the research may not even be conducted if the researchers can get the fish they need from other researchers who already have permits.

Permit 1152

Permit 1152 would allow the ODFW to annually capture, tissue sample, PIT- (or other) tag, and release SR spr/sum chinook during the course of six separate research projects (see proposed action). No other listed species would be taken during the research. The take would actually be divided among five of the projects because under Project 1, the researchers would only observe some adult fish and take some samples from the carcasses of others—neither activity would result in measurable harm to the listed fish. Under the other five projects, the juvenile fish would be captured using screw traps, dip nets, seines, electrofishing, and irrigation diversion trap boxes. Some adult fish may be captured when the researchers are angling for bull trout. All the take will take place in the Grande Ronde and Imnaha Rivers in Oregon. Brief Descriptions of the five projects follow:

Project 2

Project 2 (see Attachment B) will capture juvenile chinook salmon using several methods including rotary screw traps, seining, dipnetting, and electrofishing. Prior to sampling, juvenile chinook salmon will be anesthetized with MS-222 at approximately 60 mg/L. Fish will either be released immediately at the collection site, or after they have fully recovered from anesthesia and handling, in the vicinity of where they were collected. Rotary screw traps will be used to collect juvenile spring chinook salmon during their migration from the rearing areas. The traps will be equipped with live boxes which can safely hold the numbers of chinook salmon expected to be trapped during the trapping time intervals. The traps will be checked at varying time intervals dependent upon river conditions and the number of fish being captured. All juvenile spring chinook salmon will be removed from the traps for enumeration, sampling, and to determine if they already have PIT tags. Fish will be sampled as quickly as possible and allowed to recover fully before release into the river. Fish will be marked with PIT tags, a paint mark, or a caudal fin nick. PIT tags will be injected into the abdominal cavity using modified syringes that have been sterilized in alcohol. PIT tags are expected to remain in the fish for the fish's lifetime. Paint marks will be applied sub-cutaneously with a Pan-Jet marking instrument. Marks will be placed in the skin over the insertion of the ventral fins or in the caudal fin tissue. Paint marks are expected to remain visible on the fish for approximately three months.

Juvenile spr/sum chinook salmon will also be collected by snorkelers herding fish into seines in summer. The fish will be marked with PIT tags, or a paint mark, for a mark-recapture population estimate or to estimate parr-to-smolt survival. Scales may be sampled from larger (> 100 mm fork length) individuals during summer to determine age. Juveniles will be captured in dipnets by snorkelers during winter for PIT-tagging to estimate overwinter survival. In addition, juvenile spring chinook salmon may be captured by electrofishing during sampling for juvenile steelhead in areas not conducive to seining. During the summer sampling, the ODFW will visually inspect pools for the presence of adult spring chinook salmon before seining. If adult spring chinook salmon are present, then the pool will not be sampled.

Project 3

Researchers may capture juvenile spring chinook salmon while electrofishing to estimate abundance of residual hatchery steelhead. Captured spr/sum chinook salmon will be anesthetized, measured and released.

Project 4

Under Project 4, researchers may capture juvenile chinook salmon in a trap box that redirects fish from an irrigation ditch. These fish would then be returned immediately to the river downstream of the diversion after the trap box is checked.

Project 5

Under Project 5, the researchers may capture juvenile chinook salmon by electrofishing while targeting residual bull trout for collection of tissues for genetic analysis. Any captured juvenile chinook salmon will be released immediately. Adult spring chinook salmon may be taken by angling while angling for adult bull trout to attach radio transmitters. Adult spr/sum chinook salmon will be released immediately without being removed from the water.

Project 6

Under Project 6, the researchers may capture juvenile chinook salmon by electrofishing while sampling for species distribution and abundance in streams for which ODFW has limited information. All juvenile chinook salmon would be released immediately after they are identified.

The take amounts being requested for permit 1152 are displayed in the following table. Note that the take for all projects except for Project 5 is of juveniles only.

Table 6. Requested Take of Juvenile Spr/sum Chinook Salmon by Project and Activity for Permit 1152.

Project	Take Activity	Requested Take	Unintentional Mortality*
Project 2	C/H/R	124,450	
Project 2	C/H/T/M/TS/R	19,500	2,053
Project 3	C/H/R	120	6
Project 4	C/H/R	1,000	10
Project 5 (Adult)	C/H/R	9	0
Project 5 (Juvenile)	C/H/R	660	33
Project 6	C/H/R	600	30

(C=Capture, H=Handle, T=Tag, M= Mark R=Release, TS=tissue sample.)

*The "Unintentional Mortality" in the first two rows of the table total is for the entire operation—capturing, handling, tagging, and sampling (some of the fish). It was not possible to separate the mortality rates associated with tagging and sampling the fish from those associated with simply capturing, handling, and releasing them.

This means that the research, in its entirety, will capture 3.4% of the entire SR spr/sum chinook outmigration and will kill some 0.05% of it. It will capture 0.02% of the recent five-year geometric mean of returning adults and kill none of them. It should also be added that the researchers will observe/harass a number of juvenile and adult SR spr/sum chinook and some spawned-out, dead, or dying fish may inadvertently be captured in the screw traps (a total of perhaps 60). The effects on the ESU of these actions are negligible. As to the number of fish to be killed—it is impossible to determine what the long-term negative effect of killing 0.05% of the outmigration will be. In all likelihood, it is negligible. The number is very small and the benefits to be gained are very large. The information gathered in this research generates critical information on the yearly outmigration and, as such, is be used to help operate the hydropower system on a year-to-year basis. And because, the research will help managers determine populations structures in the upper Snake River basin, it will be used to direct habitat restoration and spr/sum chinook recovery projects.

<u>Permit 1156</u>

Permit 1156 would allow the Dynamac Corporation (acting as an agent of the EPA) to annually capture, handle, and release juvenile and adult SR spr/sum chinook, fall chinook, and steelhead during the course of research designed to gather water quality information and help enforce Clean Water Act standards. The research would take place in various parts of the Salmon and

Pahsimeroi River subbasins. The fish would be captured using backpack-and raft mount electrofishing equipment. The juveniles would be measured and examined, allowed to recover, and returned immediately to the river. If any adult fish are shocked, the electrofishing equipment would be turned off, and fish would be allowed to swim away. It should be noted that for the purposes of delineating take, electrofishing is considered "handling" because it has a larger effect than simply observing/harassing the fish. Nonetheless, in this instance, none of the adult fish would actually be handled by humans. The researchers are requesting the following levels of take:

Table 7. Requested Take by ESU, Life Stage and Activity for Permit 1156.

ESU/Species	Life Stage	Take Activity	Requested Take	Unintentional Mortality
SR Spr/sum Chinook	Juvenile	C/H/R	10	1
SR Spr/sum Chinook	Adult	C/H/R	2	0
SR Fall Chinook	Juvenile	C/H/R	5	1
SR Fall Chinook	Adult	C/H/R	2	0
SR Steelhead	Juvenile	C/H/R	15	1
SR Steelhead	Adult	C/H/R	6	0

(C=Capture, H=Handle, R=Release.).

The effect of these losses is as close to zero as it is possible to get. There is simply no way to discern what negative effect the handling or the death of one juvenile of each listed species would have on a local level, let alone on the ESU level.

Though the negative effects of the research are almost zero, the researchers will take the following steps to reduce them even further: (1) consulting with local district biologists to minimize the possibility of even encountering listed fish, (2) training the electrofishing crews for two weeks, (3), using a very low pulse rate on the equipment to minimize harm to adult fish, (4) keeping holding and handling time to a minimum, and (5) not using chemicals to sedate fish. Given these measures, the already stated Permit Conditions (page 4), and the need for Clean Water Act enforcement and baseline water quality information this study fulfills, the small losses to be incurred are entirely discountable.

<u>Permit 1194</u>

Permit 1194 would allow the NWFSC to annually capture, PIT-tag, and release up to 47 adult SR spr/sum chinook salmon. Two of these fish may die as an unintended result of the research, though none are actually expected to die. The fish will be captured at Bonneville Dam. For the most part, the researchers will tag fish that have already been anesthetized as part of other research projects. The fish will be injected with a PIT-tag and will have a dorsal Peterson disk tag attached to them so they may easily be recognized (and the PIT-tag detection equipment tested). They will then be taken below the fish ladder and allowed to pass up it on their own.

The impact of this amount of take must be measured in terms of the effect on the ESU as a whole because there is no way to determine from what portion of the ESU the fish originate. Therefore the researchers are planning to handle up to 0.09% of the recent five-year geometric mean of spr/sum returns to the Snake River basin and may kill (though it is not likely) 0.004% of them.

However, it is important to note that all these percentages numbers are probably smaller in actuality. There are two reasons for this. First, the 50,000 SR spr/sum chinook expected to return over Lower Granite Dam already take into account upstream mortalities. So the numbers of returning fish to be found at Bonneville Dam are undoubtedly larger—and therefore the fraction to be affected is undoubtedly smaller. Second, the numbers are derived from recent five-year geometric means, and in the most recent years the returns have skyrocketed, with as many as 170,000 fish returning in 2001 (NMFS 2003).

Thus, the negative effect that would be generated by the research is entirely negligible—especially given the fact that most of the fish will already have been captured and anesthetized for other research and there is a low probability that any will die at all. This, taken with the fact that the already low percentages are, for a number of reasons, probably much lower and that the proper operation of the PIT-tag detector at Bonneville is critical to determining many important facts about adult salmonid behavior and survival means that whatever lasting negative impact the research has would be discountable.

<u>Permit 1205</u>

Permit 1205 would allow the ODEQ to annually capture—using backpack electrofishing equipment—juvenile SR spr/sum and fall chinook salmon. The captured fish will quickly be identified, measured, examined for abnormalities, etc., allowed to recover, and immediately be released back to the stream. The fish will not be anesthetized or handled in any other way. The work will take place in several streams of Northeast Oregon—usually in Union and Wallowa Counties.

The amounts of take being requested are displayed in the following table:

Table 8. Requested Take by ESU, Life Stage and Activity for Permit 1205.

ESU/Species	Life Stage	Take Activity	Requested Take	Unintentional Mortality
SR Spr/sum Chinook	Juvenile	C/H/R	160	8
SR Fall Chinook	Juvenile	C/H/R	120	6

(C=Capture, H=Handle, R=Release.).

Please note that the numbers displayed above are maxima for the first year only. It is expected that the amount of take will decrease every year of the permit, and it is possible that no fish at all will be taken in the last two years. In any case, the amounts to be taken represent 0.004% and 0.01% of the 2003 spr/sum and fall chinook outmigrations, respectively. The number of fish that would, at a maximum, be killed represent 0.0002% of the spr/sum chinook outmigration and 0.0006% of the fall chinook outmigration. These losses are negligible—especially in view of the fact that the surveys will generate important information on the biotic communites in the fishes' spawning/rearing areas; information that will eventually be used to help restore habitat and recover the listed fish.

Permit 1290—Modification 1

Permit 1290 would allow the NWFSC to increase the number of juvenile SR spr/sum chinook and fall chinook they annually capture during research activities in the Columbia River Estuary. The fish would be captured using purse seines, killed, and sampled for pathogens. (Though some SR fall chinook would be released unharmed.)

The amount of increased take being requested is four SR spr/sum chinook—all to be killed—and 55 SR fall chinook, 25 of which would be killed. Those 25 dead fish would represent 0.0002% of the SR spr/sun chinook outmigration. The four dead fall chinook represent a loss of 0.002% of the total outmigration. The adverse effects of these take levels are negligible—particularly in light of the fact that the research will yield critical information on the presence of pathogens for all listed species in the Columbia River Estuary, and early knowledge of such pathogens may be very helpful in preventing harm to listed fish.

Permit 1291—Modification 2

Permit 1291 would allow the USGS to increase the number of fish they annually capture, handle, and tag. The fish are juvenile SR sockeye, spr/sum and fall chinook, and steelhead. The fish will be collected out of the juvenile bypass systems at the John Day Dam and diverted into a monitoring facility. Smolt Monitoring Program (SMP) personnel will anesthetize them and transfer them to a sorting trough. At the trough, SMP and USGS personnel will identify fish by species and rearing type (clipped or unclipped), enumerate them, and move them to a holding tank for recovery. Some fish will be set aside as research fish to be radio-tagged. All remaining fish will be held in a recovery tank following standard SMP procedures. Once recovered, all fish will be released back into the river through the juvenile bypass system. As stated above, the preferred site for collection of all target species is John Day Dam. However, as in years past, it may be difficult to obtain all the needed fish from the daily SMP sample, therefore additional fish may need to be collected at McNary and/or Bonneville dams.

The fish to be tagged would be anesthetized in a 20 L bucket using a buffered solution of 70 mg/L MS-222 with an artificial slime restorer solution. In general, the daily SMP sample is sorted and fish are set aside for the pre-tag holding period of 12-48 hours before the transmitters are implanted. This holding period allows time for gut evacuation, which allows the fish to better tolerate the implantation procedures. The radio tags would be surgically or gastrically implanted—depending on conditions. The determination of which implantation procedure will be used is based on a variety of factors. If study fish are to be evaluated for a short period and the numbers of fish to be tagged are high, gastric implantation would be used. If the fish will be monitored for longer periods and/or the number of fish to be released is smaller, the transmitters may be implanted surgically. Fish condition and water temperature would also play a role in the decision.

In either case, the fish would be treated with great care under sterile conditions. After implantation the fish would be placed into a 20 L bucket containing oxygenated water for recovery. When fish recover equilibrium (<5 min) they are transferred via the 20 L bucket to a 125 L holding container. These containers are perforated to allow for water circulation and are held within a large metal tank along with other containers of fish. Approximately 24 hours after tagging is complete, each perforated container would be moved to a release site downstream from the dam. Fish condition would be monitored continuously during transport.

The changes in requested levels of take are displayed in the following table.

Table 9. Requested Take by ESU, Life Stage, and Activity for Permit 1291.

ESU/Species	Life Stage	Take Activity	Requested Take	Unintentional Mortality
SR Sockeye	Juvenile	C/H/R	+202	+3
SR Spr/sum Chinook	Juvenile	C/H/R	+109	-6
SR Spr/sum Chinook	Juvenile	C/H/T/R	+135	+8
SR Fall Chinook	Juvenile	C/H/R	+75	0
SR Fall Chinook	Juvenile	C/H/T/R	+19	+1
SR Steelhead	Juvenile	C/H/R	+534	+3
SR Steelhead	Juvenile	C/H/T/R	+141	+12

(C=Capture, H=Handle, T=Tag, R=Release)

This means that the take will have the following effect on the juvenile outmigrations of the species to be taken (over and above that already permitted):

Table 10. Percentage of the 2003 Outmigrations Likely to be Affected by Permit 1291.

ESU/Species	Life Stage	% of Outmigration Taken*	% Mortalities*
SR Sockeye	Juvenile	0.3%	0.005%
SR Spr/sum Chinook	Juvenile	0.006%	0.00004%
SR Fall Chinook	Juvenile	0.006%	0.00009%
SR Steelhead	Juvenile	0.05%	0.001%

*The number of fish taken and the mortalities are totals for the C,H,R, and C,H,T,R portions of the research.

Again, the context for effect here is the number of fish expected to die. This is because the fish that are merely captured are unlikely to suffer any lasting ill-effects. Moreover, most of those fish are being captured under another research program covering the activities of the SMP; thus, many of the mortalities ascribed here to Permit 1291 are actually analyzed under another permit. Nonetheless, they are grouped together here with the fish expected to die as a result of the tagging operation. In that way, it is certain that the mortality numbers are an overestimate (probably more than double) of what effect this permit will add to an already established program. But even given that overestimate, the numbers are so small that it cannot be determined what overall negative effect the mortalities would have on the ESUs.

Though the negative effects are negligible, the USGS will work to reduce them even further. Much of what they intend by way of mitigation is described above. Nonetheless, it is worth noting that the USGS personnel will handle the fish only when necessary; complete the anesthetization and implantation as quickly and safely as possible (with fish condition as the highest priority); use an artificial slime restorer and a buffer when during the anesthetization process; administer antibiotics intra-peritoneally; and disinfect all surgical instruments; modify the implantation technique to the size and condition of the fish to minimize the stress associated with tagging; net fish only when necessary and only with sanctuary nets; and provide oxygen and high-flow water in to help the fish recover from the tagging procedures. Given these measures, the permit conditions listed on page 4, and the critical nature of the information being gathered with respect to fish behavior and survival, the negative effects of the research can be discounted.

Permit 1322—Modification 2

Modification 2 of Permit 1322 would authorize the NWFSC to increase the number of juvenile SR spr/sum and fall chinook salmon they annually take in the Lower Columbia River estuary. The NWFSC proposes to beach seine near the Astoria Bridge and place trapnets in Cathlamet Bay. In addition to their current level of take, the NWFSC proposes to capture (using beach seines and trap nets), anesthetize, scan for tags, measure, weigh, and release, and additional 344 SR fall chinook salmon (two of which would die as an unintentional result of the research) and lethally take another 38 (over what is already permitted). They would also lethally take another 29 juvenile SR Spr/sum chinook salmon. The lethal take in both instances is for stomach content, scale, and otolith analyses.

This means that the researchers would take an additional 0.03% of the expected SR fall chinook outmigration and kill 0.004% of them. Also, they would kill an additional 0.0007% of the expected SR spr/sum chinook outmigration. It is impossible to determine what negative effect losses this small would have on the respective ESUs.

Even though the effect of the proposed take is infinitesimally small, the NWFSC proposes to use the following measures to minimize and mitigate that effect: All possible steps will be taken to remove fish from the seines and nets as quickly and gently as possible. Fish are immediately placed into estuarine water with aeration. To minimize the stress to all caught fish, the cod end of the beach seine and trapnet will never be completely out of the water. Dip nets with reservoir bags will be used to dip fish out of the seine to allow fish to remain in estuarine water when handled. If catches appear to be larger than anticipated, the duration and size of the hauls can be controlled to reduce catch volume (NWFSC 2001b). Given these actions, the small amount of increased take, and the beneficial uses to which the information would be put, the increased take is discountable.

Permit 1366—Modification 1

Permit 1366 would allow the OCFWRU and the ICFWRU to annually capture, tag, and release juvenile SR sockeye, spr/sum and fall chinook, and steelhead at Lower Granite, McNary, and Bonneville Dams. They will also do extensive radiotelemetry studies on the fish once they are tagged. Some of the chinook and steelhead juveniles would be sacrificed to obtain physiological information.

The OCFWRU is requesting the following levels of take:

Table 11. Requested Take by ESU, Life Stage, and Activity for Permit 1366.

ESU/Species	Life Stage	Take Activity	Requested Take	Unintentional Mortality
SR Sockeye	Juvenile	C/H/R	12	1
SR Spr/sum Chinook	Juvenile	C/H/T/R	40	2
SR Spr/sum Chinook	Juvenile	LT	70	N/A
SR Fall Chinook	Juvenile	C/H/T/R	156	13
SR Fall Chinook	Juvenile	LT	490	N/A
SR Steelhead	Juvenile	C/H/T/R	391	10
SR Steelhead	Juvenile	LT	97	N/A

(C=Capture, H=Handle, T=Tag, R=Release, LT=Lethal Take)

This signifies that the research will have the following impacts on listed SR sockeye, chinook, and steelhead:

Table 12. Percentage of the 2003 Outmigration Likely to be Affected by Permit 1366.

ESU/Species	Life Stage	% of Outmigration Taken*	% Mortalities*
SR Sockeye	Juvenile	0.02%	0.002%
SR Spr/sum Chinook	Juvenile	0.003%	0.002%
SR Fall Chinook	Juvenile	0.06%	0.05%
SR Steelhead	Juvenile	0.03%	0.007%

*The number of fish taken and the mortalities are totals for the C,H,R, LT, and C,H,T,R portions of the research.

Because the researchers will be operating at dams on the mainstem Columbia and Snake Rivers, the context for determining effect is the entire outmigration of natural and artificially propagated spring chinook and steelhead. As the table above illustrates, the researchers will kill, at most, a few hundredths of a percent of the outmigration. This is so small a number as to have almost no effect at all. Even so, the researchers will try to get it as close to zero as possible: Any indirect mortalities of listed juvenile fish will be used in place of direct mortalities. All non-targeted fish will be released after no more than 24 hours in the holding tanks. No additional handling will occur. Sampling procedures allow researchers to select only those fish suitable for the research. Fish are kept in water at all times. Non-target fish will be immediately removed from the samples before anesthetization and placed back in area from which they were removed. Targeted fish not sacrificed will be handled carefully and will be anesthetized before sampling and allowed to recover in a holding tank before release. Also, the researchers will coordinate with other agencies to avoid duplicating efforts whenever possible. Given all these efforts, the small number of fish that would be killed and the crucial nature of the information the research would generate with respect to fish survival and behavior and various modes of operating the hydropower complex and the transportation program, the negative effects can be considered negligible.

<u>Permit 1379</u>

Permit 1379 would allow CRITFC to annually capture, anesthetize, measure, (sometimes take tissue samples from), and release naturally and artificially propagated juvenile and adult SR sockeye, spring chinook, and steelhead during the course of three different scientific studies in the Hanford Reach of the mid-Columbia River, at Bonneville Dam, and at Tumwater Dam on the Wenatchee River. However, only one of these projects—Project 2, Adult Chinook, Sockeye, and Coho Sampling at Bonneville Dam—may actually affect the species considered in this Opinion.

Under this study, the researchers will capture, anesthetize, take tissue samples from and release up to 251 adult SR spr/sum chinook salmon, 50 adult fall chinook salmon, and three adult sockeye salmon. One spr/sum chinook and one fall chinook may die as an inadvertent result of this process—though it is unlikely (they have lost one fish in the last five years of running this study). This means that a maximum of 0.002% of the recent five-year average returns of spr/sum chinook may be killed and 0.1% of the recent five-year geometric mean return of fall chinook may be killed—though the percentages are probably smaller in actuality. There are two reasons for this. First, the return numbers represent those fish expected to make it all the way back to the upper Lower Granite Dam. Therefore, any mortality that occurs at Bonneville Dam would be taken out of a larger number of returning fish because not all are expected to survive the journey upriver through several more dams and reservoirs. Second, in recent years the total returns to the upper Columbia have risen dramatically—with more than 150,000 spr/sum chinook and 8,700 fall chinook returning over Lower Granite Dam in 2001 (NMFS 2003). But even if those two dead fish do represent the full 0.002% and 0.1% run mortalities, it is impossible to determine what lasting negative effect those losses would have on the ESUs' viability. This is particularly true in that the information being gathered for the research is critical to determining run composition and age structure for the upriver stocks—information that is used to help adjust harvest management regimes and determine stock status on a yearly basis. Thus the (possible) loss of one adult SR spr/sum chinook and one adult SR fall chinook is negligible.

Permit 1403

Permit 1403 would allow the NWFSC to annually capture, anesthetize, measure, release, and lethally take SR spr/sum chinook salmon and SR steelhead during the course of two projects designed to evaluate the effects of marine-derived nutrients on salmonid populations in several locations throughout the Salmon River subbasin in Idaho. A third project will involve taking samples from up to 90 dead adult carcasses—but that research will have no effect on and listed ESU. Most of the fish will be captured using seines, baited minnow traps, and dipnets, though electrofishing may be used in some instances. The sacrificed fish will be sampled for a dorsal muscle plug that will be used in determining (by stable isotope analysis) the degree to which the fish are affected by the various nutrient enrichment methods being tried. That is, the researchers will use the tissue samples to determine the most effective way of getting the fish the nutrients they need to survive their early life stages. (The samples will also be examined for the presence of whirling disease.)

The amounts of take being requested are displayed in the following table:

Table 13. Requested Take by ESU, Life Stage, and Activity for Permit 1403.

ESU/Species	Life Stage	Take Activity	Requested Take	Unintentional Mortality
SR Spr/sum Chinook	Juvenile	C/H/R	3,600	234
SR Spr/sum Chinook	Juvenile	LT	1,230	N/A
SR Steelhead	Juvenile	C/H/R	3,600	234
SR Steelhead	Juvenile	LT	1,080	N/A

(C=Capture, H=Handle, T=Tag, R=Release, LT=Lethal Take)

This signifies that the research will have the following impacts on listed SR sockeye, chinook, and steelhead:

Table 14. Percentage of the 2003 Outmigration Likely to be Affected by Permit 1403.

ESU/Species	Life Stage	% of Outmigration Taken*	% Mortalities*
SR Spr/sum Chinook	Juvenile	0.08%	0.03%
SR Steelhead	Juvenile	0.3%	0.1%

*The mortalities are totals for the LT and the unintentional take associated with the C,H,R.

In actuality, however, the take numbers are not likely to remain at these levels. If the researchers are able to gather the information they need by simply taking fin clips from the captured fish (which they determine in the first season), the mortality numbers will drop markedly. Moreover, the research is designed to evaluate several different methods for adding nutrients to (fertilizing) upriver areas and thereby directly helping to rebuild local stocks. Such fertilization has the potential to substantially increase salmonid survival during the early life stages. At this (beginning) point it is necessary to sacrifice the fish to determine how effective the various habitat enrichment methods are. Considering the great potential for stream fertilization to help recover listed salmonid species, the initial losses generated by this research are discountable.

Permit 1406

Permit 1406 would allow the NWFSC to annually capture, handle, tag, and lethally take SR spr/sum chinook salmon and steelhead during the course of two studies taking place largely in the Salmon River drainage of Idaho.

Study 1

Under Study 1, the researchers would use seines and some electrofishing to capture juvenile SR spr/sum chinook and steelhead in various streams of the Salmon River drainage. Some previously PIT-tagged juvenile chinook would be collected at the Little Goose Dam juvenile bypass facility. These fish would be dip-netted from the bypass facility, anesthetized, scanned and measured. They would then be allowed to recover and returned to the river. The rest of the fish (the great majority, in fact) would be captured from their natal stream, anesthetized, tagged with a PIT-tag, allowed to recover, then placed in a live cage in the stream and allowed to return volitionally. The requested levels of take are displayed in the following table.

Table 15. Requested Take by ESU, Life Stage, and Activity for Study 1.

ESU/Species	Life Stage	Take Activity	Requested Take	Unintentional Mortality
SR Spr/sum Chinook	Juvenile	C/H/R	12,870	272
SR Spr/sum Chinook	Juvenile	C/T/R	39,000	952
SR Spr/sum Chinook	Juvenile	C/S/R	1,700	10
SR Steelhead	Juvenile	C/H/R	7,500	66
SR Steelhead	Juvenile	C/T/R	12,050	106

(C=Capture, H=Handle, T=Tag, S=scan, R=Release)

This signifies that the research will have the following impacts on listed SR sockeye, chinook, and steelhead:

Table 16. Percentage of the 2003 Outmigration Likely to be Affected by Permit Study 1.

ESU/Species	Life Stage	% of Outmigration Taken*	% Mortalities*
SR Spr/sum Chinook	Juvenile	1.3%	0.03%
SR Steelhead	Juvenile	1.1%	0.02%

*The outmigration taken and the mortality figures are totals for the C/H/R, C/T/R, and the C/S/R activities.

In actuality, however, theses percentages would be much lower—perhaps as little as half, or less than those displayed. There are two reasons for this: First, the great majority of the fish to be taken (in the tagging portion of the study) will be in the parr life stage rather than the smolt. And therefore the numbers to be taken would come out of a much larger pool than that made up of outmigrating smolts. Second, the researchers will adjust their take to be sure that they take SR chinook only in areas where at least twenty redds had been noted in the previous year. In past years this has meant that the researchers collected fish from as few as three streams and as many as 17. Thus the take numbers displayed above represent absolute maxima that would likely rarely be reached—particularly given the fact that researchers are largely targetting parr. But even if the full number of smolts were to be killed, it is impossible to determine the long-term negative effect those losses would represent. The loss of a few hundredths of a percent of each ESU must be juxtaposed with the substantial benefits that would accrue from the research. The research will be used, on a yearly basis, to help determine the best way to run the Federal Columbia River Hydropower System—particularly in terms of water releases—to benefit the fish as they migrate to the ocean. In view of this, and the fact that the take numbers will likely never be as high as those displayed above, the losses are discountable.

Study 2

Under study 2, the NWFSC would annually take SR spr/sum chinook and steelhead in the same manner as described above under Study 1—except that a number of fish will also be tissue sampled at screw traps and hatchery weirs operating under other ESA section 10 permits. The tissue sampling would entail taking a 1-1.5mm fin clip. In addition, some of the captured fish would be sacrificed for allozyme sampling.

The requested levels of take are displayed in the following table.

Table 17. Requested Take by ESU, Life Stage, and Activity for Study 2.

ESU/Species	Life Stage	Take Activity	Requested Take	Unintentional Mortality
SR Spr/sum Chinook	Juvenile	C/H/R	1,520	30
SR Spr/sum Chinook	Juvenile	C/H/TS/R	5,000	75
SR Spr/sum Chinook	Juvenile	LT	1,000	N/A
SR Steelhead	Juvenile	C/H/R	2,000	38
SR Steelhead	Juvenile	C/H/TS/R	3,250	50
SR Steelhead	Juvenile	LT	1,000	N/A

(C=Capture, H=Handle, T=Tag, TS=Tissue Sample, R=Release, LT=Lethal Take)

This signifies that the research will have the following impacts on listed SR spr/sum chinook and steelhead:

Table 28. Percentage of the 2003 Outmigration Likely to be Affected by Study 2.

ESU/Species	Life Stage	% of Outmigration Taken*	% Mortalities*
SR Spr/sum Chinook	Juvenile	0.2%	0.03%
SR Steelhead	Juvenile	0.5%	0.1%

*The outmigration taken and mortality figures are totals for the C/H/R, C/T/R, TS, and LT activities.

In actuality, however, these figures are likely to be much lower over the course of the five-year permit. There are several reasons for this. First, many of the fish to be fin-clipped will already be taken under other permits (for screw traps, hatcheries, etc.) and therefore the only added increment of harm is due to the extra mortality the clipping may cause. Second, the lethal take numbers may in fact be zero in most years. This is because the allozyme sampling—800 of the

1,000 fish of each species—would be done only twice over the five years of the permit. In addition, the other 200 fish of each species (sampling for some hatchery stocks) may not even be sacrificed at all, depending on whether the co-managers deem it appropriate. Third, the great majority of the fish to be taken will be in the parr life stage rather than the smolt. And therefore the numbers to be taken would come out of a much larger pool than that made up of outmigrating smolts. Fourth, the researchers will adjust their take to be sure that they take SR chinook only in areas where at least twenty redds had been noted in the previous year. In past years this has meant that the researchers collected fish from as few as three streams and as many as 17. Thus the take numbers displayed above represent absolute maxima that would likely rarely be reached—particularly given the fact that the researchers are largely targetting parr and the lethal take numbers will approach zero in most years. But even if the full number of smolts were to be killed, it is impossible to determine the long-term negative effect those losses would represent. The research has implications for salmonid recovery throughout the Northwest and California. It is designed to shed light on how best to use hatchery technology in recovering listed species and will help measure the effectiveness of such hatchery reforms throughout the region—particularly in a conservation context. In light of this—and the fact that the lethal take will actually be far less than half that displayed (over the life of the permit)—the potential losses are discountable.

Permit 1410

Permit 1410 would allow the NWFSC to annually capture, handle, measure, and release adult, SR spr/sum and fall chinook, and lethally take juvenile SR sockeye, chinook, and steelhead during a series of trawls in the nearshore environment off the mouth of the Columbia River. The NWFSC is requesting the following levels of take:

Table 19. Requested Take by ESU, Life Stage, Origin, and Activity for Permit 1410.

ESU/Species	Life Stage	Take Activity	Requested Take	Unintentional Mortality
SR Sockeye	Juvenile	LT	1	0
SR Spr/sum Chinook	Juvenile	LT	52	0
SR Spr/sum Chinook	Adult	C/H/R	9	0
SR Fall Chinook	Juvenile	LT	10	0
SR Fall Chinook	Adult	C/H/R	6	0
SR Steelhead	Juvenile	LT	4	0

(C=Capture, H=Handle, R=Release, LT=Lethal Take.)

This signifies that the following percentages of the out migration are likely to be affected by the research.

Table 20. Percentage of the 2003 Outmigration Likely to be Affected by Permit 1410.

ESU/Species	Life Stage	% Mortalities*
SR Sockeye	Juvenile	0.002%
SR Spr/sum Chinook	Juvenile	0.001%
SR Fall Chinook	Juvenile	0.001%
SR Steelhead	Juvenile	0.0003%

*Because all juveniles taken in the trawl would be killed, there is no reason to differentiate between the fish taken and the fish killed.

Because the nine adult SR spr/sum chinook and the six SR fall chinook would not be killed (and it is entirely possible that not even that many will be taken), it is not expected that the research will have anything more than a very temporary negative effect on the fish. On the ESU scale, the capture of these fish cannot be differentiated from no effect at all. As to the juvenile fish, the numbers to be killed represent such small fractions of the outmigration that it would be impossible to resolve any negative effect on the local population scale, let alone the ESU as a whole. This is especially true when one considers the fact that a great deal of information will be taken from the dead fish and used (eventually) to develop a set of hydropwer management scenarios to benefit juvenile salmonid survival, growth, and health.

Permit 1421

Permit 1421 would allow the USFWS to annually capture, handle, and release juvenile and adult SR sockeye, spr/sum chinook, fall chinook, and steelhead. The researchers would use boat-and backpack electrofishing gear, some fyke nets and some baited minnow traps to capture the fish. The adult fish would not actually be physically handled. If they are encountered during the electrofishing operations, the equipment would immediately be shut off and the adults allowed to escape. The juveniles would be anesthetized, marked with a flourescent dye, sampled for stomach contents by gastric lavage, allowed to recover, and released. None of the captured adults fish are expected to die as a result of the research. The USFWS is requesting the following levels of take:

Table 21. Requested Take by ESU, Life Stage, Origin, and Activity for Permit 1421.

ESU/Species	Life Stage	Take Activity	Requested Take	Unintentional Mortality
SR Sockeye	Juvenile	C/H/M/SS/R	1	0
SR Sockeye	Adult	C/H/R	1	0
SR Spr/sum Chinook	Juvenile	C/H/M/SS/R	4	1
SR Spr/sum Chinook	Adult	C/H/R	2	0
SR Fall Chinook	Juvenile	C/H/M/SS/R	3	1
SR Fall Chinook	Adult	C/H/R	1	0
SR Steelhead	Juvenile	C/H/M/SS/R	4	1
SR Steelhead	Adult	C/H/R	2	0

(C=Capture, H=Handle, M=Mark, SS=Stomach Sample, R=Release.)

Because none of the adult fish would be killed (and it is entirely possible that not even those numbers will be taken), it is not expected that the research will have anything more than a very temporary negative effect on the adult fish. On the ESU scale, the capture of these fish cannot be differentiated from no effect at all. The same is nearly true of the juvenile fish. At most, the research would kill a few ten-thousandths of a percent of the outmigration—and it is more likely that none at all would be killed. It is therefore impossible to determine what negative effect this will have on the ESU. Given this, and the fact that the research would generate important information about the use of certain pesticides in areas where anadromous fish are present, the possible negative effect of the research is entirely negligible.

Cumulative Effects

Cumulative effects are those effects of future Tribal, state, local or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation. For the purpose of this analysis, the action area is that part of the SR Basin described in the Description of the Proposed Actions section above. Future Federal actions, including the operation of hydropower systems, hatcheries, fisheries, and land management activities will be reviewed through separate section 7 consultation processes. Non-Federal actions that require authorization under section 10 of the ESA, and that are not included within the scope of this consultation, will be evaluated in separate consultations.

Future Tribal, state, and local government actions will likely to be in the form of legislation, administrative rules or policy initiatives. Government and private actions may include changes in land and water uses, including ownership and intensity, any of which could impact listed species or their habitat. Government actions are subject to political, legislative, and fiscal uncertainties. These realities, added to geographic scope of the action area which encompasses numerous government entities exercising various authorities and the many private landholdings, make any analysis of cumulative effects difficult and frankly speculative. This section identifies representative actions that, based on currently available information, are reasonably certain to occur. It also identifies some goals, objectives, and proposed plans by government entities, however, NMFS is unable to determine at this point in time whether any proposals will in fact result in specific actions.

State Actions

Each state in the Columbia River Basin administers the allocation of water resources within its borders. Most streams in the basin are overappropriated even though water resource development has slowed in recent years. The state governments are cooperating with each other and other governments to increase environmental protections, including better habitat restoration, hatchery, and harvest reforms. NMFS also cooperates with the state water resource management agencies in assessing water resource needs in the basin, and in developing flow requirements that will benefit listed fish. During years of low water, however, there could be insufficient flow to meet the needs of the fish. These government efforts could be discontinued or even reduced, so their cumulative effects on listed fish is unpredictable.

The states of Idaho and Oregon have various strategies and programs designed to improve the habitat of listed species and assist in recovery planning, including the Oregon Plan, a framework for developing watershed restoration projects. The state is developing a water quality improvement scheme through the development of TMDLs (total maximum daily loads). These programs could benefit the listed species if implemented and sustained.

In the past, the Oregon and Idaho economies were heavily dependent on natural resources, with intense resource extraction activity. The states' economies have has changed over the last decade and it is likely to continue changing—with less large scale resource extraction, more targeted extraction methods, and significant growth in other economic sectors. Growth in new businesses is creating urbanization pressures with increased demands for buildable land, electricity, water supplies, waste disposal sites, and other infrastructure. Economic diversification has contributed to population growth and movement in the states, a trend likely to continue for the next few decades. Such population trends will place greater demands in the action area for electricity, water, and buildable land; will affect water quality directly and indirectly; and will increase the need for transportation, communication, and other infrastructure development. The impacts associated with economic and population demands will affect habitat features, such as water quality and quantity, which are important to the survival and recovery of the listed species. The overall effect is likely to be negative, unless carefully planned for and mitigated.

Local Actions

Local governments will be faced with similar but more direct pressures from population growth and movement. There will be demands for intensified development in rural areas as well as increased demands for water, municipal infrastructure, and other resources. The reaction of local governments to such pressures is difficult to assess at this time without certainty in policy and funding. In the past, local governments in the action area generally accommodated additional growth in ways that adversely affected listed fish habitat. Also there is little consistency among local governments in dealing with land use and environmental issues so that any positive effects from local government actions on listed species and their habitat are likely to be scattered throughout the action area.

In Oregon, local governments are considering ordinances to address aquatic and fish habitat health impacts from different land uses. These programs are part of state planning structures. Some local government programs, if submitted, may qualify for a limit under the NMFS' ESA section 4(d) rule which is designed to conserve listed species. Local governments also may participate in regional watershed health programs, although political will and funding will determine participation and therefore the effect of such actions on listed species. Overall, without comprehensive and cohesive beneficial programs and the sustained application of such programs, it is likely that local actions will not have measurable positive effects on listed species and their habitat, but may even contribute to further degradation.

Tribal Actions

Tribal governments will continue to participate in cooperative efforts involving watershed and basin planning designed to improve fish habitat. The results from changes in Tribal forest and agriculture practices, in water resource allocations, and in changes to land uses are difficult to assess for the same reasons discussed under State and Local Actions. The earlier discussions related to growth impacts apply also to Tribal government actions. Tribal governments will need to apply comprehensive and beneficial natural resource programs to areas under their jurisdiction to produce measurable positive effects for listed species and their habitat.

Private Actions

The effects of private actions are the most uncertain. Private landowners may convert current use of their lands, or they may intensify or diminish current uses. Individual landowners may voluntarily initiate actions to improve environmental conditions, or they may abandon or resist any improvement efforts. Their actions may be compelled by new laws, or may result from growth and economic pressures. Changes in ownership patterns will have unknown impacts. Whether any of these private actions will occur is highly unpredictable, and the effects even more so.

Summary

Non-Federal actions are likely to continue affecting the listed species. The cumulative effects in the action area are difficult to analyze considering the geographic landscape of this opinion, the political variation in the action area, the uncertainties associated with government and private actions, and the changing economies of the region. Whether these effects will increase or decrease is a matter of speculation; however, based on the trends identified in this section, the adverse cumulative effects are likely to increase. Although state, Tribal, and local governments have developed plans and initiatives to benefit listed fish, they must be applied and sustained in a comprehensive way before NMFS can consider them "reasonably foreseeable" in its analysis of cumulative effects.

Integration and Synthesis of Effect

The vast majority (more than 93% in all cases) of the SR fish that will be captured, handled, tagged, etc., during the course of the proposed research are expected to survive with no long-term effects. Moreover, all the capture, handling, and holding methods will be minimally intrusive, of short duration, and the research will provide certain benefits in every case. Nonetheless, it is necessary to paint an overall picture of the impacts the proposed activities are likely to have—and because the impacts of brief handling, tagging, etc., can be discounted in those instances where the fish suffer no lasting harm, the impacts are measured by the number of fish the research would actually kill. The following tables summarize the effects all of the proposed permits are likely to have on the listed species.

Table 22. Requested Take of Endangered SR Sockeye

	Adult		Juvenile	
Permit	HANDLE	MORTALITY	HANDLE	MORTALITY

Action	C, H, R	C, T/M, S, CT, R	INTENTIONAL	UNINTENTIONAL*	C, H, R	C, T/M, S, CT, R	INTENTIONAL	UNINTENTIONAL*
1124	0	125	0	3	50	3,000	100	60
1291	0	0	0	0	202	0	0	3
1366	0	0	0	0	12	0	0	1
1379	0	3	0	0	0	0	0	0
1410	0	0	0	0	0	0	1	0
1421	1	0	0	0	0	1	0	0
TOTAL	1	128	0	3	264	3,000	101	64

Key: C,H,R = Capture, Handle, Release; C, T/M, CT,S, R = Capture, Tag/mark, Capture for Transport, Sample, Release. *Remember, the unintentional mortalities come *out of* the total requested for the C, H, T/M, S, CT, and R activities.

Table 23. Requested Take of Threatened SR Spr/sum Chinook

Permit	Adult				Juvenile			
	HANDLE		MORTALITY		HANDLE		MORTALITY	
Action	C,H,R	C, T/M, S, CT, R	INTENTIONAL	UNINTENTIONAL*	C,H,R	C, T/M, S, CT, R	INTENTIONAL	UNINTENTIONAL*
1124	0	2,600	0	6	0	305,000	750	1,400
1134	50	2,970	0	16	1,674,433	65,100	0	9,021
1152	9	0	0	0	126,830	19,500	0	2,132
1156	2	0	0	0	10	0	0	1
1194	0	47	0	2	0	0	0	0
1205	0	0	0	0	160	0	0	8
1290	0	0	0	0	0	0	4	0
1291	0	0	0	0	109	135	0	2
1322	0	0	0	0	0	0	29	0
1366	0	0	0	0	0	40	70	2
1379	0	251	0	1	0	0	0	0
1403	0	0	0	0	0	3,600	1,230	234
1406	0	0	0	0	14,390	45,700	1,000	1,339
1410	9	0	0	0	0	0	52	0
1421	2	0	0	0	0	4		1
TOTALS	72	5,868	0	25	1,815,932	439,079	3,135	14,140

Key: C,H,R = Capture, Handle, Release; C, T/M, CT,S, R = Capture, Tag/mark, Capture for Transport, Sample, Release. *Remember, the unintentional mortalities come *out of* the total requested for the C, H, T/M, S, CT, and R activities.

Table 24. Requested Take of Threatened SR Fall Chinook

	Adult	Juvenile

Permit Action	HANDLE C, H, R	HANDLE C, T/M, S, CT, R	MORTALITY INTENTIONAL	MORTALITY UNINTENTIONAL*	HANDLE C, H, R	HANDLE C, T/M, S, CT, R	MORTALITY INTENTIONAL	MORTALITY UNINTENTIONAL*
1124	0	1,600	0	4	0	6,000	0	130
1134	0	0	0	0	2,000	8,000	0	100
1140	0	0	0	0	0	0	3	0
1156	2	0	0	0	5	0	0	1
1205	0	0	0	0	120	0	0	6
1290	0	0	0	0	30	0	25	0
1291	0	0	0	0	75	0	0	1
1322	0	0	0	0	344	0	38	2
1366	0	0	0	0	0	156	490	13
1379	0	50	0	1	0	0	0	0
1410	6	0	0	0	0	0	10	0
1421	1	0	0	0	0	3	0	1
TOTALS	9	1,650	0	5	2,574	14,159	566	254

Key: C,H,R = Capture, Handle, Release; C, T/M, CT,S, R = Capture, Tag/mark, Capture for Transport, Sample, Release.
*Remember, the unintentional mortalities come *out of* the total requested for the C, H, T/M, S, CT, and R activities.

Table 25. Requested Annual Take of Threatened SR Steelhead

	Adult				Juvenile			
Permit	HANDLE		MORTALITY		HANDLE		MORTALITY	
Action	C, H, R	C, T/M, S, CT, R	INTENTIONAL	UNINTENTIONAL*	C, H, R	C, T/M, S, CT, R	INTENTIONAL	UNINTENTIONAL*
1134	105	0	0	0	164,550	26,790	0	3,094
1156	6	0	0	0	15	0	0	1
1291	0	0	0	0	534	141	0	15
1366	0	0	0	0	0	391	97	10
1403	0	0	0	0	3,600	0	1,080	234
1406	0	0	0	0	9,500	13,300	1,000	261
1410	0	0	0	0	0	0	4	0
1421	2	0	0	0	0	4	0	1
TOTALS	113	0	0	0	178,199	40,626	2,181	3,616

Key: C,H,R = Capture, Handle, Release; C, T/M, CT,S, R = Capture, Tag/mark, Capture for Transport, Sample, Release.
*Remember, the unintentional mortalities come *out of* the total requested for the C, H, T/M, S, CT, and R activities.

Table 26. Maximum Annual Take Percentages for SR Sockeye, Spr/sum Chinoook, Fall Chinook, and Steelhead

	Adult				Juvenile			
	%HANDLE		%MORTALITY		%HANDLE		%MORTALITY	
ESU	C,H,R	C,T/M, S, R	INTENTIONAL	UNINTENTIONAL	C,H,R	C,T/M, S, R	INTENTIONAL	UNINTENTIONAL
Sockeye	1.6%	201%	0	4.8%	0.5%	5.4%	0.2%	0.1%
Spr/sum C	0.1%	11.7%	0	0.05%	43.1%	10.4%	0.07%	0.3%
Fall C.	10.3%	189%	0	0.6%	0.24%	1.3%	0.05%	0.02%
Steelhead	0.76%	0	0	0	12.2%	2.8%	0.15%	0.25%

Thus all the activities, when taken together, would kill, at most, a few tenths of a percent of the adult or juvenile SR fish—with the possible exception of adult SR sockeye (more on that in a moment). However, it is important to keep in mind the fact that these estimates are absolute maxima that will in all probability will never be approached, let alone reached. The following paragraphs discuss the overall research impacts on adult and juvenile fish.

Adults

The impacts on adult fish range from none at all (in the case of steelhead) to what would appear, at first glance, to be a rather heavy impact on SR sockeye salmon—a critically endangered fish. As stated before, however, the research action that would have the most impact on sockeye is actually critical to their survival. The research conducted under Permit 1124 over the last ten years or so has arguably helped keep the fish from going extinct before now and it is certainly critical to helping the fish as they make their way back from the brink of extinction. The possible death of three fish in this instance is more than offset by the benefit the fish receive. The potential loss of four SR fall chinook salmon adults is similarly balanced by the benefits to be derived. The fish health monitoring and fish survey research conducted by the IDFG is critical to the continued recovery of the all the listed salmonids in Idaho. The loss of up to four adult SR fall chinook salmon in this instance is a small enough fraction of recent returns that it is difficult to discern what lasting harm that loss would do to the ESU even if no benefit accrued. As to the spr/sum chinook, the possible loss of a few hundredths of a percent of the recent average returns is negligible in any reference frame and, too, the research would actually benefit the fish. In all, the deaths of these fish would have a small impact on the ESUs (though, again, the losses are not likely reach the maxima displayed above), but the loss of so few fish would in no way cause lasting harm to the health of any of the ESUs.

Juveniles

As Table 26 illustrates, the total amounts of estimated lethal take for all research would equal 0.3% of the SR sockeye outmigration, approximately 0.4% of the SR spr/sum chinook outmigration, 0.07% of the SR fall chinook outmigration, and 0.4% of the SR steelhead outmigration. However, and for a number of reasons, those percentages are in actuality probably much smaller. First, as stated earlier in the Opinion, many of the Permits would, in most years, not take the full number of outmigrants (e.g., Permit 1406). Second, it is important to remember that every estimate of lethal take for the proposed studies has purposefully been inflated to account for potential accidental deaths and it is therefore very likely that fewer juveniles will be killed by the research than stated in Table 25 and 26—possibly many fewer. Third, some of the studies will specifically affect sockeye, steelhead, and chinook in the smolt stage, but others will not. These latter studies are described as affecting "juveniles," which means they may affect steelhead yearlings, parr, or even fry: life stages represented by many more individuals than reach the smolt stage—perhaps as much as an order of magnitude more. Therefore the 0.3%, 0.4%, 0.07%, and 0.4% figures were derived by (a) overestimating, *in two ways*, the number of fish likely to be killed, and (b) treating each dead juvenile fish as a smolt when some of them clearly won't be. Thus the actual numbers of juvenile salmonids the research is likely to kill are undoubtedly smaller than the stated figures.

But even if all the proposed lethal take did occur (intentional and unintentional), and *all* the dead juvenile fish treated as smolts, it would be very difficult to translate those numbers into actual effects on the species. Even if the subject were three or four adults killed out of a population of a thousand (0.1% is another way of expressing the fraction "one thousandth"), it would be hard to resolve an adverse effect. And in this instance, that effect is even smaller because the loss of a smolt is in no way equivalent to the loss of an adult in terms of species survival and recovery. This is due to the fact that a great many smolts die before they can mature into adults—a good conservative estimate would be that 90% of outmigrating salmonid smolts in do not survive to return as adults (NMFS 2002b). This means that some 90% of the fish that may be lethally taken would likely be killed during the natural course of events. Therefore the research, even in the worst possible scenario, would kill likely the (maximum) equivalent of three of four adults out of ten thousand—and that small an amount of loss would have a negligible adverse effect on any of the ESUs.

Nonetheless, regardless of their magnitudes, the negative effects associated with the proposed permits (in terms of both juvenile and adult losses) must be juxtaposed with the benefits to be derived from the research (see descriptions of the individual permits). Those benefits range from gathering fish census data that will help managers run the entire Columbia River hydropower system to give the greatest benefit to the migrating fish (Permits 1124, 1134) to helping determine better ways to help the fish survive downstream passage through the dams (Permit 1291) to outrightly rescuing stranded fish (Permit 1124). In all, the fish will derive some benefit from every permit considered in this Opinion. The amount of benefit will vary, but in some cases it will certainly be significant. Therefore, in deciding whether to issue the permits considered here, NMFS must compare the tangible benefits they will produce (some of which are potentially critical to the survival and recovery of the species in question) with the negligible adverse effects they will cause. However, for the purposes of ESA section 7(a)(2), NMFS must consider the proposed actions' adverse effects when deciding whether the contemplated actions will appreciably reduce the likelihood of the MCR steelhead's survival and recovery—the critical determination in issuing any biological opinion.

CONCLUSIONS

After reviewing the current status of the endangered and threatened species that are the subject of this consultation, the environmental baseline for the action area, the effects of the proposed section 10(a)(1)(A) permit actions, and cumulative effects, it is NMFS' biological opinion that issuance of the permit actions, as proposed, and the funding of the proposed activities by Federal agencies, if applicable, are not likely to jeopardize the continued existence of endangered SR sockeye salmon, threatened SR spring/summer chinook salmon, threatened SR fall chinook salmon, or threatened SR steelhead or result in the destruction or adverse modification of their respective designated critical habitats.

Coordination with the National Ocean Service

None of the activities contemplated in this Biological Opinion will be conducted in or near a National Marine Sanctuary. Therefore, these activities will not have an adverse effect on any National Marine Sanctuary.

CONSERVATION RECOMMENDATIONS

Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to develop additional information, or to assist Federal agencies in complying with their obligations under section 7(a)(1) of the ESA. NMFS believes the following conservation recommendation is consistent with these obligations, and therefore should be implemented:

> NMFS shall monitor actual annual takes of listed fish species associated with scientific research and enhancement activities, as provided to NMFS in annual reports or by other means, and shall adjust annual permitted take levels if they are deemed to be excessive or if cumulative take levels are determined to operate to the disadvantage of the Listed species.

REINITIATION OF CONSULTATION

Consultation must be reinitiated if: The amount or extent of cumulative annual takes specified in the permits is exceeded or is expected to be exceeded; new information reveals effects of the actions that may affect the listed species in a way not previously considered; a specific action is modified in a way that causes an effect on the ESA-listed species that was not previously considered; or a new species is listed or critical habitat is designated that may be affected by the action (50 CFR 402.16).

MAGNUSON-STEVENS ACT ESSENTIAL FISH HABITAT CONSULTATION

"Essential fish habitat" (EFH) is defined in section 3 of the Magnuson-Stevens Act (MSA) as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." NMFS interprets EFH to include aquatic areas and their associated physical, chemical, and biological properties used by fish that are necessary to support a sustainable fishery and the contribution of the managed species to a healthy ecosystem. EFH has been designated for Pacific salmon, groundfish, and coastal pelagic species. For information on EFH for these species, please see this website: http://www.nwr.noaa.gov/1habcon/habweb/msa.htm.

The MSA and its implementing regulations at 50 CFR 600.920 require a Federal agency to consult with NMFS before it authorizes, funds, or carries out any action that may adversely affect EFH—in this case, EFH for Pacific salmon, groundfish, and coastal pelagic species. The purpose of consultation is to develop a conservation recommendation(s) that addresses all reasonably foreseeable adverse effects to EFH. Further, the action agency must provide a detailed, written response to NMFS within 30 days of receiving an EFH conservation recommendation. The response must include measures proposed by the agency to avoid, minimize, mitigate, or offset the impact of the activity on EFH. If the response is inconsistent with NMFS' conservation recommendation the agency must explain its reasons for not following the recommendation.

However, in this instance, no conservation recommendations are necessary. As the Biological Opinion above describes, the proposed research actions are not likely, singly or in combination, to adversely affect the habitat upon which Pacific salmon, groundfish, and coastal pelagic species, depend. All the actions are of limited duration, minimally intrusive, and are entirely discountable in terms of their effects, short-or long-term, on any habitat parameter important to the fish.

LITERATURE CITED

Ainslie, B.J., J.R. Post, and A.J. Paul. 1998. Effects of pulsed and continuous DC electrofishing on juvenile rainbow trout. North American Journal of Fisheries Management 18: 905-918.

Allen, R.L., and T.K. Meekin. 1973. An evaluation of the Priest Rapids chinook salmon spawning channel, 1963-1971. Washington Department of Fisheries, Technical Report 11: 1-52, Olympia, Washington.

Barnhart, R.A. 1986. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)– steelhead. U.S. Fish and Wildlife Service, Biological Report 82(11.60).

Becker, D.C. 1970. Temperature, timing, and seaward migration of juvenile chinook salmon from the central Columbia River. Battelle Northwest Laboratories, AEC Research and Development Report, Richland, Washington.

Bell, M.C. 1986. Fisheries handbook of engineering requirements and biological criteria. U.S. Army Corps of Engineers, North Pacific Division, Portland, Oregon.

Bjornn, T.C., D.R. Craddock, and D.R. Corley. 1968. Migration and survival of Redfish Lake, Idaho, sockeye salmon (*Oncorhynchus nerka*). Transactions of the American Fisheries Society 97: 360-373.

Bordner, C.E., S.I. Doroshov, D.E. Hinton, R.E. Pipkin, R.B. Fridley, and F. Haw. 1990. Evaluation of marking techniques for juvenile and adult white sturgeons reared in captivity. American Fisheries Society Symposium 7: 293-303.

Brynildson, O.M., and C.L. Brynildson. 1967. The effect of pectoral and ventral fin removal on survival and growth of wild brown trout in a Wisconsin stream. Transactions of the American Fisheries Society 96: 353-355.

Bugert, R., P. LaRiviere, D. Marbach, S. Martin, L. Ross, and D. Geist. 1990. Lower Snake River compensation plan salmon hatchery evaluation program. 1989 Annual Report to U.S. Fish and Wildlife Service (Cooperative Agreement 14-16-0001-89525).

Burgner, R.L. 1991. The life history of sockeye salmon (*Oncorhynchus nerka*). *In* C. Groot and L. Margolis, editors. Life history of Pacific salmon. University of British Columbia Press, Vancouver, B.C.

Burgner, R.L., J.T. Light, L. Margolis, T. Okazaki, A. Tautz, and S. Ito. 1992. Distribution and origins of steelhead trout (*Oncorhynchus mykiss*) in offshore waters of the North Pacific Ocean. International North Pacific Fish Commission Bulletin 51.

Busby, P.J., Wainwright, T.C., Bryant, G.J., Lierheimer, L.J., Waples, R.S., Waknitz, F.W., and Lagomarsino, I.V. 1996. Status review of West Coast steelhead from Washington, Idaho, Oregon, and California. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NWFSC-27, 261 p.

Cannamela, D.A. 1992. Potential impacts of releases of hatchery steelhead trout "smolts" on wild and natural juvenile chinook and sockeye salmon. Idaho Department of Fish and Game, White Paper, Boise.

Conner, W.P., H.L. Burge, and R. Waitt. 2001. Snake River fall chinook salmon early life history, condition, and growth as affected by dams. Unpublished report prepared by the U.S. Fish and Wildlife Service and University of Idaho, Moscow, ID. 4 p.

Dalbey, S.R., T.E. McMahon, and W. Fredenberg. 1996. Effect of electrofishing pulse shape and electrofishing-induced spinal injury on long-term growth and survival of wild rainbow trout. North American Journal of Fisheries Management 16: 560-569.

Dwyer, W.P., and R.G. White. 1997. Effect of electroshock on juvenile arctic grayling and Yellowstone cutthroat trout growth, 100 days after treatment. North American Journal of Fisheries Management 17: 174-177.

Everest, F.H. 1973. Ecology and management of summer steelhead in the Rogue River. Oregon State Game Commission, Fisheries Research Report 7, Corvallis.

Evermann, B.W. 1895. A preliminary report upon salmon investigations in Idaho in 1894. U.S. Fish Commission Bulletin 15: 253-284.

Ferguson, J.W. 2003. Memorandum to Laurie Allen: Estimation of percentages for Listed pacific Slamon and Steelhead smolts arriving at various locations in the Columbia River Basin in 2003. Northwest Fisheries Science Center. March 20, 2003.

Fish Passage Center (FPC). 2002. Adult salmon passage counts. FPC Internet Website. <http://www.fpc.org/adult.html> (accessed June 13, 2002).

Fredenberg, W. 1992. Evaluation of electrofishing-induced spinal injuries resulting from field electrofishing surveys in Montana. Montana Department of Fish, Wildlife, and Parks Report, Helena.

Fulton, L.A. 1968. Spawning areas and abundance of chinook salmon (*Oncorhynchus tshawytscha*) in the Columbia River Basin-past and present. U.S. Fish and Wildlife Service Special Scientific Report Fisheries No. 571. 26 p.

Fulton, L.A. 1970. Spawning areas and abundance of steelhead trout and coho, sockeye, and chum salmon in the Columbia River basin– past and present. Special Scientific Report– Fisheries 618.

Gilbert, C.H. 1912. Age at maturity of Pacific coast salmon of the genus *Oncorhynchus*. Bulletin of the U.S. Fish Commission 32: 57-70.

Gustafson, R.G., T.C. Wainwright, G.A. Winans, F.W. Waknitz, L.T. Parker, and R.S. Waples. 1997. Status review of sockeye salmon from Washington and Oregon. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-33, 282p.

Hart, J.L. 1973. Pacific fisheries of Canada. Fisheries Research Board of Canada Bulletin 180: 199-221.

Hartt, A.C., and M.B. Dell. 1986. Early oceanic migrations and growth of juvenile Pacific salmon and steelhead trout. International North Pacific Fisheries Commission Bulletin 46: 1-105.

Healey, M.C. 1983. Coastwide distribution and ocean migration patterns of stream- and ocean-type chinook salmon, *Oncorhynchus tshawytscha*. Canadian Field-Naturalist 97: 427-433.

Healey, M.C. 1986. Optimum size and age at maturity in Pacific salmon and effects of size-selective fisheries. Canadian Special Publications Fisheries and Aquatic Sciences 89: 39-52.

Healey, M.C. 1991. Life history of chinook salmon (*Oncorhynchus tshawytscha*). Pages 311-393 *in* Groot, C. and L. Margolis, editors. Pacific salmon life histories. University of British Columbia Press, Vancouver, B.C.

Hollender, B.A., and R.P. Carline. 1994. Injury to wild brook trout by backpack electrofishing. North American Journal of Fisheries Management 14: 643-649.

Howe, N.R., and P.R. Hoyt. 1982. Mortality of juvenile brown shrimp (*Penaeus aztecus*) associated with streamer tags. Transactions of the American Fisheries Society 111: 317-325.

Idaho Department of Fish and Game (IDFG). 2002. Written comments submitted to National Marine Fisheries Service regarding status review.

Independent Science Group (ISG). 1996. Return to the river: Restoration of salmonid fishes in the Columbia River ecosystem. ISG, Report 96-6, for the Northwest Power Planning Council, Portland, Oregon.

Jenkins, W.E., and T.I.J. Smith. 1990. Use of PIT tags to individually identify striped bass and red drum brood stocks. American Fisheries Society Symposium 7: 341-345.

Kohlhorst, D.W. 1979. Effect of first pectoral fin ray removal on survival and estimated harvest rate of white sturgeon in the Sacramento-San Joaquin estuary. California Department of Fish and Game 65: 173-177.

Marmorek, D.R., and C.N. Peters, editors. 1998. Plan for analyzing and testing hypotheses (PATH): Preliminary decision analysis report on Snake River spring/summer chinook. ESSA Technologies Ltd., Vancouver, B.C.

Matthews, G.M., and R.S. Waples. 1991. Status review for Snake River spring and summer chinook salmon. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-F/NWC-200, 75 p.

Matthews, K.R., and R.H. Reavis. 1990. Underwater tagging and visual recapture as a technique for studying movement patterns of rockfish. American Fisheries Society Symposium 7: 168-172.

McClure, M., B. Sanderson, E. Holmes, C. Jordan, P. Kareiva, and P. Levin. 2000b. Revised Appendix B of standardized quantitative analysis of the risks faced by salmonids in the Columbia River basin. Northwest Fisheries Science Center, National Marine Fisheries Service, Seattle, Washington. September.

McMichael, G.A. 1993. Examination of electrofishing injury and short-term mortality in hatchery rainbow trout. North American Journal of Fisheries Management 13: 229-233.

McMichael, G. A. L. Fritts, and T. N. Pearsons, 1998. Electrofishing Injury to Stream Salmonids; Injury Assessment at the Sample, Reach, and Stream Scales. North American Journal of Fisheries Management 18:894-904.

McNeil, F.I., and E.J. Crossman. 1979. Fin clips in the evaluation of stocking programs for muskellunge (*Esox masquinongy*). Transactions of the American Fisheries Society 108: 335-343.

McPhail, J.D., and C.C. Lindsey. 1970. Freshwater fishes of Northwestern Canada and Alaska. Bulletin of the Fisheries Research Board of Canada 173: 381.

Mealy, S.P. 1997. Letter re: State of Idaho's comments on the proposed listing of Snake River steelhead for protection under the Federal Endangered Species Act. Idaho Department of Fish and Game. February 11.

Mears, H.C., and R.W. Hatch. 1976. Overwinter survival of fingerling brook trout with single and multiple fin clips. Transactions of the American Fisheries Society 105: 669-674.

Miller, R.J., and E.L. Brannon. 1982. The origin and development of life-history patterns in Pacific salmon. *In* E.L. Brannon and E.O. Salo, editors. Proceedings of the salmon and trout migratory behavior symposium. University of Washington Press, Seattle.

Moring, J.R. 1990. Marking and tagging intertidal fishes: Review of techniques. American Fisheries Society Symposium 7: 109-116.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-35, 443 p.

NMFS. 1991. Factors for decline: A supplement to the notice of determination for Snake River spring/summer chinook salmon under the Endangered Species Act. NMFS, Protected Resources Division, Portland, Oregon.

NMFS. 1996. Endangered Species Act Section 7 Consultation on the Issuance and Funding of Section 10(a)(1)(A) Permits and Modifications for Scientific Research/Enhancement and Monitoring Involving Snake River Salmon for 1996-2000. Consultation # 960013. March 28, 1996.

NMFS. 1997. Status Review Update for West Coast Steelhead from Washington, Idaho, Oregon, and California. Prepared by the West Coast Steelhead Biological Review Team. July 7, 1997.

NMFS. 1999. Evaluation of the status of chinook and chum salmon and steelhead hatchery populations for ESUs identified in final listing determinations. Memorandum from M. Schiewe thru U. Varanasi to W. Stelle, dated March 4, 1999.

NMFS. 2000a. Guidelines for Electrofishing Waters Containing Salmonids Listed under the Endangered Species Act. Protected Resources Division, NMFS, Portland, Oregon. June 2000.

NMFS. 2000b. Reinitiation of Endangered Species Act Section 7 Consultation on the Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin. Consultation # F/NWR/2001/00249. December 21, 2000.

NMFS. 2002a. National Marine Fisheries Service ESA Section 7 Consultation Biological Opinion and Magnuson–Stevens Act Essential Fish Habitat Consultation on 27 research actions affecting Snake River salmon and steelhead. NMFS Protected Resources Division, Portland, Oregon. February, 2002. Consultation Number F/NWR/1999/01858.

NMFS. 2002b. Consultation on the issuance of several ESA section 10(a)(10)(A) research actions in the Middle Columbia River. August, 2002.

NMFS. 2003. Preliminary Conclusions Regarding the Updated Status of Listed ESUs of West Coast Salmon and Steelhead. West Coast Salmon Biological Review Team, NWFSC. Co-manager Review Draft. February, 2003.

NOAA. 1992. Final Rule, Endangered and Threatened Species: Threatened Status for Snake River Spring/Summer Chinook Salmon and Threatened Status for Snake River Fall Chinook Salmon. April 22, 1992. Federal Register 57(78): 14653-14663.

NOAA. 1993a. Notice of Interim Policy, Endangered and Threatened Species: Interim Policy on Artificial Propagation of Pacific Salmon Under the Endangered Species Act. April 5, 1993. Federal Register 58(63): 17573-17576.

NOAA. 1993b. Final Rule, Endangered and Threatened Species: Designated Critical Habitat for Snake River Sockeye Salmon, Snake River Spring/Summer Chinook Salmon, and Snake River Fall Chinook Salmon. December 28, 1993. Federal Register 58(247): 68543-68554.

NOAA. 1999. Final Rule, Endangered and Threatened Species: Revision of Designated Critical Habitat for Snake River Spring/Summer Chinook Salmon. October 25, 1999. Federal Register 64(205): 57399-57403.

National Research Council (NRC). 1996. Upstream: Salmon and society in the Pacific Northwest. NRC, Report of the Committee on Protection and Management of the Pacific Northwest Anadromous Salmonids, the Board on Environmental Studies and Toxicology, and the Commission on Life Sciences. National Academy Press, Washington, D.C.

Nickelson, T.E., J.W. Nicholas, A.M. McGie, R.B. Lindsay, D.L. Bottom, R.J. Kaiser, and S.E. Jacobs. 1992. Status of anadromous salmonids in Oregon coastal basins. Oregon Department of Fish and Wildlife, Research and Development Section, Corvallis, and Ocean Salmon Management, Newport, Oregon.

Northwest Fisheries Science Center (NWFSC), NMFS. 2001b. Application for an ESA section 10(a)(1)(A) permit (1322) for annual takes of Listed fish species associated with scientific research. May 30, 2001.

Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Fish and Wildlife (WDFW). 1999. Status report, Columbia River fish runs and fisheries, 1938-1998. ODFW, Portland and WDFW, Olympia.

Pacific Fishery Management Council (PFMC). 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A: Description and Identification of Essential Fish Habitat, Adverse Impacts and Recommended Conservation Measures for Salmon. Pacific Fishery Management Council, Portland, Oregon.

Peery, C.A., and T.C. Bjornn. 1991. Examination of the extent and factors affecting downstream emigration of chinook salmon fry from spawning grounds in the upper Salmon River. Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Unpublished Report, Moscow.

Peters, C.N., D.R. Marmorek, and I. Parnell, editors. 1999. Plan for analyzing and testing hypotheses (PATH) decision analysis report for Snake River fall chinook salmon. ESSA Technologies Ltd., Vancouver, B.C.

Prentice, E.F., and D.L. Park. 1984. A study to determine the biological feasibility of a new fish tagging system. Annual Report of Research, 1983-1984. Project 83-19, Contract DE-A179-83BP11982.

Prentice, E.F., T.A. Flagg, and C.S. McCutcheon. 1987. A study to determine the biological feasibility of a new fish tagging system, 1986-1987. Bonneville Power Administration, Portland, Oregon.

Prentice, E.F., T.A. Flagg, and C.S. McCutcheon. 1990. Feasibility of using implantable passive integrated transponder (PIT) tags in salmonids. American Fisheries Society Symposium 7: 317-322.

Rondorf, D.W., and W.H. Miller. 1994. Identification of the spawning, rearing, and migratory requirements of fall chinook salmon in the Columbia River Basin. Prepared for the U.S. Dept. of Energy, Portland, OR. 219 p.

Sharber, N.G., and S.W. Carothers. 1988. Influence of electrofishing pulse on spinal injuries in adult rainbow trout. North American Journal of Fisheries Management, 8: 117-122.

Sharber, N.G., S.W. Carothers, J.P. Sharber, J.C. deVos, Jr., and D.A. House. 1994. Reducing electrofishing-induced injury of rainbow trout. North American Journal of Fisheries Management 14: 340-346.

Snyder, D.E. 1992. Impacts of electrofishing on fish. Report of Colorado State University, Larval Fish Laboratory to the U.S. Bureau of Reclamation, Salt Lake City, Utah, and Glen Canyon Environmental Studies Team, Flagstaff, Arizona.

Snyder, D.E. 1995. Impacts of electrofishing on fish. Fisheries 20(1): 26-27.

Stolte, L.W. 1973. Differences in survival and growth of marked and unmarked coho salmon. Progressive Fish-Culturist 35: 229-230.

Thompson, K.G., E.P. Bergersen, and R.B. Nehring. 1997. Injuries to brown trout and rainbow trout induced by capture with pulsed direct current. North American Journal of Fisheries Management 17: 141-153.

Toner, R.C. 1960. A study of some of the factors associated with the reestablishment of blueback salmon (*Oncorhynchus nerka*) into the upper Wallowa River system. Appendix A *in* R.N. Thompson and J.B. Haas, editors. Environmental survey report pertaining to salmon and steelhead in certain rivers of eastern Oregon and the Willamette River and its tributaries. Part 1: survey reports of eastern Oregon rivers. Fish Commission of Oregon, Clackamas.

Waples, R. S. 1991. Defenition of "Species" Under the Endangered Species Act: Application to Pacific Salmon. U.S. Department of Commerce, NOAA Technical Memorandum, NMFS, F/NWC-194. 29 pp.

Waples, R.S., O.W. Johnson, and R.P. Jones, Jr. 1991a. Status review for Snake River sockeye salmon. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-F/NWC-195, 23 p.

Waples, R.S., R.P. Jones, Jr., B.R. Beckman, and G.A. Swan. 1991b. Status review for Snake River fall chinook salmon. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-F/NWC-201, 73p.

Welch, H.E., and K.H. Mills. 1981. Marking fish by scarring soft fin rays. Canadian Journal of Fisheries and Aquatic Sciences 38: 1168-1170.